FACULTY OF MEDICINE AND HEALTH SCIENCES

NON-CLASSICAL GENITAL GENDER-AFFIRMING SURGERY IN BORN-FEMALE TRANSGENDER AND GENDER DIVERSE INDIVIDUALS. A RETROSPECTIVE COHORT ANALYSIS OF A SINGLE-CENTER EXPERIENCE.

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Preface

Prior to commencing this master's thesis, I was captivated by the subject of surgery in transgender and gender-diverse individuals. I sought to gain a comprehensive understanding of the intricacies of this healthcare domain and was poised to make substantive contributions to its ongoing scholarly inquiry. This exploration has been guided by the expertise and support of two individuals at Ghent University Hospital, whose contributions have been invaluable to the completion of this thesis.

I extend my deepest gratitude to my co-promotor, Dr. Wietse Claeys, whose unwavering dedication and insightful guidance have played a pivotal role in shaping the trajectory of this research. His wealth of knowledge and tireless commitment to advancing the understanding of gender-affirming surgery has been an inspiration throughout this process.

I am equally indebted to my distinguished promotor, Prof. Dr. Anne-Françoise Spinoit, whose expertise in the field of gender-affirming surgery has provided invaluable insights and direction. Prof. Dr. Spinoit's mentorship has been instrumental in refining the scope and focus of this thesis, and her unwavering support has been a source of great encouragement.

This thesis is a humble attempt to shed light on a topic of paramount importance in contemporary society. The exploration of atypical genital gender-affirming surgery is not only intellectually stimulating but also addresses a critical gap in the education and awareness surrounding this subject. As our understanding of gender diversity evolves, we must engage with these complex and multifaceted issues in a manner that is both compassionate and informed.

I hope that this work can serve as a stepping stone, inspiring further research and dialogue in this vital area of study. It is my sincere hope that the insights contained herein contribute to a more inclusive and empathetic approach to gender-affirming care.

Lot van Heugten

03/11/2023

Social outreach

Een beschrijvende studie van vermannelijkende niet-klassieke transgender operaties.

Sommige transgender en gender diverse personen ervaren gender dysforie, een gevoel van discomfort veroorzaakt doordat het geboortegeslacht niet in overeenstemming is met het gender van die persoon. Om genderdysforie te behandelen kunnen deze personen verschillende stappen van een transitieproces doorlopen, zoals hormonale behandeling, stemtraining, en chirurgie. De keuze voor behandeling en de mate waarin een persoon zich wil engageren in één of meerdere van deze stappen, is sterk individueel bepaald. Genitale gender-affirmerende chirurgie is een van de mogelijke operaties die uitgevoerd kunnen worden. Hierbij worden de geboortegenitaliën omgebouwd naar de genitaliën van het gender waarmee de persoon zich identificeert. Deze thesis focust zich op vermannelijkende genitale gender chirurgie. Klassiek omvat deze procedure het verwijderen van de vagina, het opbouwen van een penis (aan de hand van metoidioplastie of falloplastie), een verlenging van de plasbuis tot de top van de penis, en de opbouw van de balzak. Naast de personen die kiezen voor klassieke gender chirurgie, zijn er een aantal personen die specifiek geen vagina laten wegnemen of niet opteren voor een verlenging van de plasbuis. We spreken in deze gevallen over ‘niet-klassieke genitale gender operaties’. In deze thesis worden de niet-klassieke vermannelijkende genitale gender operaties beschreven en wordt er gekeken naar het voorkomen van complicaties en tevredenheid na de operatie. Via een retrospectieve cohorte studie werden twee datasets gemaakt van alle patiënten die een niet-klassieke operatie ondergingen in het Universitair Ziekenhuis in Gent.

De meest aangehaalde redenen om voor de niet-klassieke chirurgische benadering te kiezen, waren seksuele motivatie (geen vagina verwijdering) en geen wens om rechtstaand te plassen (geen verlenging van de plasbuis). Andere redenen waren vooraf bestaande plasproblemen, de angst voor complicaties, en enkel een wens voor het uiterlijk van een penis, zonder functie. Verder blijkt uit de resultaten dat individuen die geen plasbuis laten verlengen, minder complicaties hebben achteraf. Voor patiënten die ervoor kozen geen vagina verwijdering te ondergaan, konden niet meer of minder complicaties aangetoond worden in vergelijking met een groep die wel complete vaginaverwijdering onderging.

Dit is een van de eerste onderzoeken naar niet-klassieke genitale gender-affirmerende chirurgie. Aanvullend onderzoek is nodig om voor- en nadelen van deze geïndividualiseerde chirurgische benadering te bevestigen en te vergelijken met een grote groep die de klassieke operatie ondergingen. Er moet in toekomstig onderzoek tevens meer aandacht besteed worden aan tevredenheid postoperatief.

Contents

Abstract

Background: Classical genital gender-affirming surgery (gGAS) has been extensively discussed in the literature in recent decades. Along with societal changes, applications for non-classical genital gender-affirming surgery (gGAS) are increasing, however, very little is known about these specific approaches.

Aim: This thesis aimed to make an overview of all transgender and gender diverse (TGD) individuals who opted for non-classical gGAS (NCgGAS) in the Ghent Universal Hospital, and to (i) describe clinical outcomes following the non-classical surgery with a particular emphasis on complications; (ii) explore the motives underlying a non-classical treatment request, including the role of a gender diverse gender identity and the role of the healthcare provider; and (iii) to describe patients' satisfaction on voiding function, aesthetic appearance, and sexual function.

Method: Retrospective data was collected from the electronic patient register from all TGD individuals who underwent gGAS in our gender clinic from January 2006 up until July 2023. Individuals who underwent gGAS either without complete vaginectomy or urethral lengthening (UL) were included, creating a pool of 27 individuals who received non-classical metoidioplasty and 42 individuals who received non-classical phalloplasty. Simple statistical analysis combined with the Mann-Whitney U test and the Chi-Square or Fisher's Exact test was used.

Results: (i) Significantly fewer urethral complications were reported in individuals who underwent gGAS without UL. No conclusions could be conducted about whether or not vaginal preservation is a risk factor for the occurrence of urethral complications. However, the risk of hematoma and organ perforation is reduced if no vaginectomy is performed. (ii) The most reported underlying motives for NCgGAS were no wish for standing micturition, sexual motivation, and the fear of complications. (iii) Comprehensive evaluation of patient-reported outcomes was not possible due to a lack of data.

Strengths and limitations: This thesis provides one of the first complete overviews of masculinizing NCgGAS surgery performed in a single-center. Limitations, however, are the retrospective nature of the study, the long recruitment period resulting in protocol changes throughout the study period, incompleteness of data, and a lack of validated questionnaires.

Conclusions: gGAS without UL significantly reduces urethral complications. Non-classical approaches may be important in some TGD individuals due to a diversity of reasons and should therefore be incorporated in pre-operative counseling.

(Nederlands – Dutch)

Achtergrond: Klassieke genitale gender-affirmerende operaties (gGAO) zijn reeds uitgebreid beschreven in de literatuur. Door een samenloop van onder andere sociale en maatschappelijke veranderingen, wordt er tegenwoordig een stijgende vraag gezien naar niet-klassieke gGAO. Over dit type operatie zijn tot nog toe weinig dingen bekend.

Doelstelling: Deze thesis heeft als doel een overzicht te geven van alle transgender en gender diverse individuen die ervoor kozen een masculiniserende niet-klassieke gGAO te ondergaan in het Universitair Ziekenhuis te Gent. In deze thesis worden (i) postoperatieve uitkomsten beschreven waarbij specifiek gefocust wordt op complicaties, (ii) de onderliggende reden voor de aanvraag van een niet-klassieke operatie, en (iii) tevredenheid van individuen aangaande plasfunctie, esthetische, en seksuele tevredenheid.

Methode: Data van alle individuen die GAO ondergingen tussen januari 2006 en juli 2023 in onze genderkliniek, werd retrospectief verzameld. Individuen die masculiniserende gGAO ondergingen zonder complete vaginectomie of zonder urethrale verlenging (UV), werden geïncludeerd. In totaal werden 69 individuen geselecteerd, waarvan 27 metoidioplastie en 42 falloplastie ondergingen. Een statistische analyse werd voor al deze individuen uitgevoerd, waarbij de Mann-Whitney U test en de Chi-Square of Fisher's Exact test gebruikt werden.

Resultaten: (i) Er werden significant minder urethrale complicaties gerapporteerd bij individuen die gGAO zonder UV lieten uitvoeren. Wat betreft vaginale preservatie, konden geen associaties met het voorkomen van urethrale complicaties aangetoond worden. Hoewel het risico op hematoomvorming en orgaanperforatie verkleind was als geen vaginectomie wordt uitgevoerd. (ii) De meest gerapporteerde onderliggende motieven voor niet-klassieke gGAO waren: geen wens voor staand te plassen, seksuele motieven, en de angst voor complicaties. (iii) Een uitgebreide evaluatie van patiënt-gerapporteerde uitkomsten was niet mogelijk door een tekort aan beschikbare gegevens.

Sterktes en zwaktes: Deze thesis is een van de eerste complete overzichten van masculinizerende niet-klassieke gGAO. Desondanks zijn er een aantal beperkingen aan deze thesis, zijnde het retrospectieve ontwerp van de studie, de lange recruteringsperiode die resulteerde in veranderingen van het protocol gedurende de onderzoeksperiode, onvolledigheid van gegevens, en een tekort aan gevalideerde vragenlijsten.

Conclusies: gGAO zonder UV verminderen de kans op het voorkomen van urethrale complicaties. Niet-klassieke benaderingen kunnen belangrijk zijn voor bepaalde TGD-individuen voor verschillende redenen, en moeten daarom geïncorporeerd worden in de preoperatieve begeleiding.

1. Introduction

1.1 Definitions

In recent decades, there has been an increasing focus on the care of transgender and gender-diverse (TGD) individuals due to the increased amount of gender-dysphoric individuals seeking care (1). Researchers estimate that approximately 0.5% of the world's population identifies as transgender or gender diverse (2). TGD individuals may, but not necessarily all of them, experience a sense of gender dysphoria. "Gender dysphoria*"* refers to discomfort or distress caused by a discrepancy between a person's gender identity and that person's sex assigned at birth (3,4).

It is important to distinguish anatomical sex, gender identity, gender expression, and sexual preference to clarify further definitions. "*Anatomical sex"* refers to the sex assigned at birth, determined by chromosomes and resulting body features including genitalia, hormones, and hair growth. "*Gender identity"* refers to an individual's internal sense of their gender, which may or may not align with their anatomical sex. "*Gender expression"* is the way a person presents their gender to others through appearance, behavior, and social interactions. "*Sexual preference"* refers to an individual's physical and emotional attraction towards others based on their gender or sex but should not be considered a component of gender (1).

A "cisgender*"* individual is someone whose gender identity is congruent with their assigned sex. Conversely, "transgender*"* describes a diverse group of individuals whose gender identity differs from their assigned sex. The term "trans-male*"* refers to a transgender individual born-female that is transitioning (or has transitioned) to a male phenotype and "transwoman*"* refers to all transgender individuals born-male doing so (1,2).

Up to one-third of all TGD individuals do not feel comfortable with the aforementioned binary perspective of gender (1,2). "*Gender diverse"* is an umbrella term referring to all those who experience their gender as outside of the binary (1–3). This group includes but is not limited to, those who experience a gender identity that lies between or outside masculine and feminine, hybridizes both, changes over time, or individuals who do not identify with any gender at all (1,2,4–7). The term "*intersex*" is used for individuals born with a disorder of sexual development (DSD), resulting in complex anatomical sex characteristics that do not fit typical male or female classifications. This group of individuals is not part of the population described in this thesis (2).

It is important to recognize that these concepts are distinct and that each individual may identify with different aspects of gender and sexuality in unique ways. This entails that not all

transgender, or gender diverse individuals experience gender dysphoria, and not all gender dysphoric individuals feel the need to seek therapy (1,2).

1.2 Therapeutic approaches for individuals experiencing gender dysphoria

In recent decades, a variety of techniques and new insights have been developed to help alleviate gender dysphoric individuals from the distress caused by their gender incongruence. Some individuals experiencing gender dysphoria may request gender-affirming medical and/or surgical treatments (1). This can be classified into three main categories: psychotherapy and changing gender roles, hormone therapy, and surgery. Since TGD individuals represent a wide variety of gender identities and expressions, no single assessment will fit every individual in every situation (1). Although gender reassignment is considered a therapeutic approach by some authors, it should not be considered as such: this approach may relieve feelings of gender dysphoria but some individuals may still experience other problems following therapy (8).

This thesis focuses particularly on all de-feminizing and masculinizing genital treatment approaches in born-female individuals. De-masculinization and feminization will therefore not be commented upon. Treatment approaches in born-female individuals that do not involve genital transformation are only briefly discussed.

1.2.1 Psychotherapy

In general, TGD individuals access psychological care at markedly high rates, with approximately 58% of this population seeking care in comparison with 3% of the general population (9,10). Reasons for seeking psychological care include getting support in accepting and exploring their gender, seeking help with coming out, accessing gender-affirming medical care, addressing mental health issues that gender dysphoria may or may not be the cause of, and learning to cope with social stigma, and discrimination against TGD individuals (9,11,12). For those experiencing gender dysphoria, psychotherapy in various formats can lead to a decrease in psychological distress (9,11,12). Psychotherapy aims to help explore their individuals' gender identity, gender roles, and gender expression and may help them in the process of changing gender expression. This involves living part-time or full-time in a gender role that aligns with their gender identity (1,12,13).

1.2.2 Hormone therapy and voice training

Some individuals experiencing gender dysphoria may opt for hormone therapy to reduce their discomfort. Hormone therapy in TGD individuals makes it possible to emphasize secondary sex characteristics toward the desired gender. Several studies reported a positive

impact of hormone therapy, whether or not combined with gender-affirming surgery, on various aspects of mental well-being and the alleviation of gender dysphoria (1,6,14–16).

Before the start of hormone therapy, it is important to discuss the effect of treatment on sexual health and fertility. All hormonal therapy is proven to have an effect on sexual function, sexual desire, sexual satisfaction, and pleasure (6,17). Moreover, it is important to discuss the option of gamete storage before starting hormone therapy, as the long-term use of cross-sex hormone therapy is associated with decreased fertility (6,17,18).

Suppressing the natal sex-differentiating hormones to block their effect on the development of gender characteristics, is usually a first step in hormone therapy, typically perceived by gonadotrophin-releasing hormones (GnRH) analogs and/or progestins (6,18). This is particularly interesting for children and adolescents presenting with gender dysphoria, as it can be used to suppress puberty preventing the development of secondary sex characteristics (6,18). Secondarily, along with the increasing prevalence of gender-diverse individuals, increased requests are seen in various individualized approaches regarding hormone therapy, as individuals may choose to reduce their natal hormone production but deliberately do not initiate cross-sex hormone therapy (6,19,20). An advantage of this treatment is the reversibility, which implies that stopping hormone intake results in a spontaneous return of the innate sex hormone and its associated effects, and a resuming of pubertal development when given to an adolescent (18,21). An alternative for individuals not desiring a treatment with hormone blockers, is the removal of ovaries, but an important consequence is irreversible infertility (18).

Following treatment with GnRH analogs, the individual may choose an adjacent treatment with cross-sexual hormones. For masculinization, testosterone preparations are used. Expected changes, among others, include lowering of the voice, interruption of menses, male-pattern facial and body hair appearance, clitoral enlargement, increased muscle mass, decreased fat mass, and atrophy of breast tissue (6,14,18,21). Complications following testosterone administration include affected fertility, polycythemia, acne, and alopecia (18,22,23).

The rate and onset of physical changes following hormone therapy vary between individuals and are correlated with the dose and the type of medication that is used. Guidelines exist to determine what type of hormone and suggested dosing to use to approximate the expected physical change for the individual (18,22). Additionally, lifelong follow-up of the effects of hormones is performed, to reduce risks as much as possible. (6,18). Subsequently, some gender-diverse individuals may wish for a lower dosage of hormones or a hormone intake for

a fixed period of time to stimulate particular irreversible changes to seek a gender profile that fits them best (24).

In addition to hormone therapy, some individuals might choose voice training therapy. The goal is to achieve a more masculine pitch without straining the vocal cords (25). If the voice therapy alone cannot result in the desired phonation, surgical procedures may be performed (25).

1.2.3 Non-genital surgery

Gender-affirming surgery (GAS), sometimes referred to as sex reassignment surgery (SRS), has become an increasingly accepted and sought-after option for some individuals experiencing gender dysphoria (26). GAS is an umbrella term that encompasses various surgical procedures aligning an individual's body with their gender identity (6). These procedures can be split up into facial gender-affirming surgery (fGAS), gender-affirming breast surgery (top surgery), and genital gender-affirming surgery (gGAS).

In individuals choosing for masculinization, fGAS is remarkably less commonly performed than feminizing fGAS. Facial masculinizing surgery involves implant placement to achieve a larger and more angulated facial structure. The low incidence of this type of operation is possibly due to the hiding effect of beard growth resulting from testosterone therapy (27). Voice surgery in masculinization is not common, as hormone therapy and voice therapy provide sufficient lowering of the voice pitch in most cases. Gender-affirming breast surgery, on the other hand, is a frequently performed masculinizing procedure (19,27). As testosterone has only a limited effect on the reduction of breast tissue, individuals may request partial or complete mastectomy, involving the removal of breast tissue and excess skin, reduction, and repositioning of the nipples, and chest contouring with liposuction (2,19,27,28).

1.3 Genital surgery in gender dysphoric TGD individuals

Part of all individuals experiencing gender dysphoria choose gGAS. There are various procedures that, depending on the individual's wishes, are performed to a greater or lesser extent.

Because of the close relationship between the genitals and the urinary tract, all types of gGAS may have an impact on genital functioning and the surrounding structures (28). It is therefore important to perform preoperative urologic screening before gGAS, to (partly) resolve pre-existing problems and thus avoid the risk of complications later (28).

Individuals seeking masculinizing gGAS can select one or more procedures from the options explained below.

A classical masculinizing surgery involves on the one hand removal of the native female genital organs (hysterectomy, ovariectomy, vaginectomy), and on the other hand the creation of surrogate masculine genital organs (creation of a neophallus, urethral lengthening, scrotoplasty, and perineal reconstruction) (2,19,28). These may be followed by secondary masculinizing procedures including glansplasty, and testicular and/or erectile prostheses (2).

1.3.1 Removal of natal female genital organs

Hysterectomy and ovariectomy can be performed through a laparoscopic or vaginal approach (19,21). In born-female TGD individuals, these procedures may lead to a substantial improvement of gender dysphoric thoughts, as there is no longer a need for gynecological consultations, and menstrual bleeding ceases, if not already been interrupted during hormone therapy (19,21).

Subsequently, individuals may opt for (total) vaginectomy following or during a hysterectomy. This is a submucosal vaginal resection, which can be performed through a combined vaginal and abdominal approach if combined with hysterectomy, or through a vaginal approach if performed as a sole procedure or in combination with masculinizing gGAS (28). The vaginal walls are dissected up to the level of the hysterectomy scar, and the remaining vaginal tissue and artery ends are coagulated (28). When performing limited submucosal removal, the vaginal introitus is partially closed, leaving a small opening for evacuation of vaginal mucus. Alternatively, if complete submucosal resection is performed, the introitus is completely closed along with perineal reconstruction.

Vaginectomy poses a risk of damage to surrounding organs (including the bladder, ureter, and rectum), as well as a risk of major hemorrhages due to abundant vascularization of the vaginal wall and the fragility of the epithelium due to testosterone therapy (21,28–30). Moreover, individuals undergoing masculinizing surgery are frequently still virgins and nulliparae, making them more susceptible to excessive bleeding during the operation since the vaginal canal is narrower, and bleeding is more difficult to stem (29,30). Possible postoperative complications entail lower urinary tract syndrome (LUTS), vaginal fistulas, perineal hematoma, mucocele or abscess formation in the vaginectomy loge, wound dehiscence, and suprapubic skin necrosis (28,31).

Initially, at Ghent University Hospital, these three surgeries were performed simultaneously to minimize the number of procedures, but studies have indicated that conducting them as separate first and second-stage procedures results in fewer complications (31). Therefore,

mastectomy, ovariectomy, and hysterectomy are generally combined in the first stage, and vaginectomy with masculinization surgeries can follow in the second stage (21,28,31). Moreover, this allows for hysterectomy to be performed completely laparoscopically and vaginectomy to be performed solely through a vaginal approach, both resulting in fewer complications (21,31).

The hormonally enlarged clitoris is not removed in masculinization surgeries but serves different purposes depending on the type of masculinizing gGAS performed. In metoidioplasty, the enlarged clitoris forms the neophallus, whereas, in phalloplasty, the clitoris is either denuded and buried under the base of the phallus, incorporated in the penoscrotal angle, or left in the natal position (32,33) (Figure 1 and 3).

1.3.2 Construction of masculine genital organs

In general, two techniques can be distinguished to create a neopenis, either a phalloplasty or a metoidioplasty are performed.

1.3.2.1 Metoidioplasty

Metoidioplasty has the goal to create an anatomically small-sized neophallus, using the hormone-hypertrophied natal clitoris and surrounding tissue. A classical metoidioplasty procedure includes clitoral release, perineal reconstruction, urethral reconstruction and lengthening, and scrotoplasty (28,34). It is intended as an end-stage masculinizing genital surgery but some centers use it as a preparatory step for phalloplasty (35).

Clitoral enlargement is achieved through 12 to 24 months of testosterone therapy (34,36,37). Some authors describe the additional use of topical testosterone therapy and/or a vacuum pump to further enhance hypertrophy (34).

For the construction of the neophallus, clitoral enhancement is performed using various procedures. Metoidioplasty can be performed without clitoral release, with dorsal or ventral release only, or by a combination of both. It is necessary to distinguish ventral and dorsal clitoral release. Ventral clitoral release requires splitting the vestibular plate and ventral angulating ligaments (28,34,35,38). Dorsal clitoral release, on the other hand, involves releasing the suspensory ligament to the pubic symphysis. A combination of both techniques enables complete stretching of the clitoris, thus providing the neophallus with the greatest possible length gain (28,34,35,38). In the final step of the metoidioplasty procedure, the penile body is reconstructed using the remaining clitoral and labia minora tissue (34).

1.3.2.2 Urethral lengthening in metoidioplasty-like procedures

The neourethra constructed during metoidioplasty consists of three parts, the native female urethra, the proximal urethra, also referred to as the fixed, horizontal, or perineal urethra, and

the distal urethra (28,39) (Figure 1). The proximal urethral part is created by tubularization of the vestibulum vagina (34,39,40). This part of the urethra now runs from the original female external meatal orifice to the hypertrophied clitoris (28) (Figure 1). The bulbospongiosus muscles are sutured in the midline to cover the fixed part of the urethra (28).

Furthermore, additional urethral lengthening (AUL) can be performed to create the distal urethra. This is only possible if a ventral release of the clitoris is performed, obtaining maximum length gain (35). To construct a distal urethra that extends to the tip of the newly created glans, additional tissue is necessary (35) (Figure 1). The most common techniques use a preputial island flap harvested from just below the glans clitoris, an inner labia minora flap, a buccal mucosa flap, harvested from the inner cheek, or a combination of the above (28,34,35,38,40). Some authors report additional protection to the neourethra when a preputial or labia minora flap is combined with a buccal mucosa flap (34,35,40).

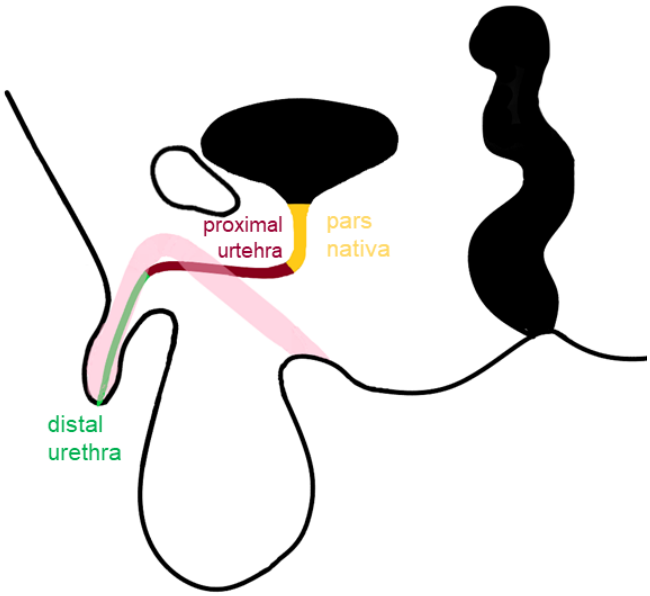

Figure 1. The urethra in born-female individuals undergoing metoidioplasty, is composed of three parts: (1) the native female urethra (*yellow*); (2) the proximal part of the urethra (*red*), requiring tubularization of the urethral plate; and (3) the distal part of the urethra (*green*), requiring AUL with a flap. The final position of the clitoris following combined ventral and dorsal clitoral release is showed in pink.

Since urethral lengthening involves the manipulation of the urethra, urethral strictures, and fistula formation are frequent complications (35). Other complications following metoidioplasty are hematoma, wound infection, delayed wound healing, flap necrosis, revision surgery due to aesthetical corrections of the mons pubis, penile skin or scrotum, urinary tract infection, and lower urinary tract symptoms (LUTS) as spraying or dribbling (28,34,38).

In general, most individuals retain natural erection and sensation of the neopenis following metoidioplasty. The technique is less invasive than phalloplasty, resulting in shorter hospitalization times and minimal scarring (2,34,36,37,41). While standing urination is possible for some individuals, it cannot be guaranteed since the final size of the neophallus depends on the individual's pre-existing anatomy and is highly associated with the size of the hormone-hypertrophied clitoris. This same consideration accounts for the capability of penetrative sexual intercourse (28,34,37,38,40,42–44).

1.3.2.3 Phalloplasty

Phalloplasty is a surgical procedure that aims to create an anatomically-sized neophallus using tissues transferred from outside of the genital area (28,41,45,46). A classical phalloplasty procedure involves perineal reconstruction, flap transfer, urethral reconstruction and lengthening, and scrotoplasty (28,45). The procedure is usually performed by two surgical teams working simultaneously, one performing genitoperineal reconstruction and the other prelevating the flap and constructing the neophallus at the donor site (47).

During genitoperineal reconstruction, the clitoris is degloved and one of the clitoral nerves is dissected. The clitoris is relocated cranially along with the dissected clitoral nerve and the fixed urethra (28). This part of the urethra is constructed in a similar way to metoidioplasty. As one of the two dorsal clitoral nerves will be connected to the neophallus, the other one is left unharmed and stays connected to the clitoris, preserving erogenous sensibility (48).

Construction of the neophallus involves the prelevation of a skin flap or skin graft from a specific part of the body (donor site), remodeling this tissue into a phalloplasty design, and connecting this neophallus to the genital area (acceptor site). A skin flap is a skin and tissue transfer where the donor blood supply is left intact, whereas a skin graft is only the transfer of a thin layer of skin without the attachment of their original blood supply. The latter is less invasive but is also less durable and has a higher chance of complications.

Depending on the proximity of the donor site to the pubic bone, a free or pedicled flap will be released (47). The blood supply of a pedicled flap is not cut from the donor site but is immediately connected to the acceptor site, whereas the blood supply of a free flap is completely disconnected and subsequently connected to the acceptor site (49). Free flap phalloplasty requires micro-surgical techniques, providing more accurate dissection but also implying longer operation times and a higher risk of complications (49). All vessels and nerves of the phalloplasty design will consequently be connected to their corresponding vessels in the perineal region (50).

Once the flap is transferred to the genital area, the surgeon uses a skin graft from another part of the body to cover the skin deficit. Several phalloplasty designs can be carried out

during surgery, depending on the chosen flap. The tube-in-tube design has the advantage of providing enough tissue for both phallic and urethral reconstruction, if not possible, the surgeon will create a composite flap where shaft and urethra are taken from separate donor sites, or they will use a skin graft for urethral reconstruction (50) (Figure 2).

In current practice, the most frequently used donor sites for phallic reconstruction are the radial free forearm (RFF) flap (41,48,50–52) and the anterolateral thigh (ALT) flap (41,47,49,50,53,54).

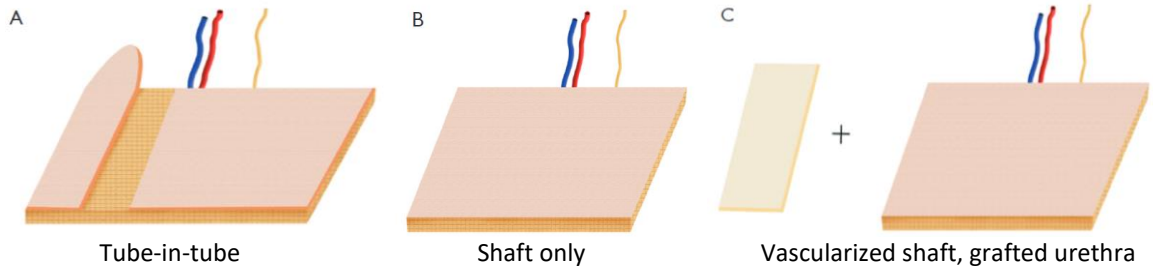

Figure 2. Illustration of various flap designs used for phalloplasty.

Note. Adapted from "Phalloplasty: Techniques and outcomes", by A. Heston, N. Esmonde, D. Dugi, J. Berli, 2019, *Translational Andrology and Urology*, *8(3)*, p. 257 (http://dx.doi.org/10.21037/tau.2019.05.05).

The RFF flap involves taking a section of skin and tissue from the forearm, which is thin and pliable with reliable vascularity, making it ideal for the tube-in-tube phalloplasty design (50,51). However, major drawbacks include a large, conspicuous scar that remains on the forearm and the need for microsurgical techniques during surgery, implying longer surgery times (49). The ALT flap is prelevated from the thigh and has the advantage that it can often be performed as a pedicled flap, thus not requiring microsurgical techniques and resulting in a lower rate of flap-related complications (41). An ALT flap may be suitable for a tube-in-tube design but then the thigh has to be extremely thin with a subcutaneous thickness of less than one centimeter, if not, an additional skin flap or graft for urethral reconstruction will be necessary (47,50). A major difficulty is the high prevalence of anatomical variations in this region, needing an assessment of the perforator anatomy preoperatively (49). Secondarily, despite the more easily concealed location, a large scar remains (41,49,53). A third technique uses a superficial circumflex iliac artery perforator (SCIAP) flap, also referred to as a groin flap (41,50,53,55). This is described as a less sensate flap but has the advantage that no microvascular anastomosis is necessary and that a less conspicuous scar is left behind (56).

Other less performed techniques include a free musculocutaneous latissimus dorsi flap (41,51,53,57), a pedicled abdominal flap (41,53,58), a para-scapular flap (49,53), a free gracilis flap (41,53,59), and an osteocutaneous free fibula flap (41,49,53).

The surgeon will provide information about the advantages and limitations of each technique, allowing the individual to make a deliberate decision depending on their expectations. In addition, the surgeon may have a preference for a particular technique that might influence the patient's choice.

1.3.2.4 Urethral lengthening in phalloplasty-like procedures

One of the most challenging aspects of phalloplasty is constructing the urethra, which is built up of three parts: the native female urethra, the fixed part of the urethra, and the pendulans urethra (48,60) (Figure 3).

The urethral construction involves bridging two sharp angles in the urethral course, which are located just below the bladder and at the beginning of the neophallus, respectively (Figure 3). These angles are subjected to higher mechanical stress and a greater risk of complications compared to other parts of the urethra. Urethral problems are usually referred to as the location of the onset of the complication (60).

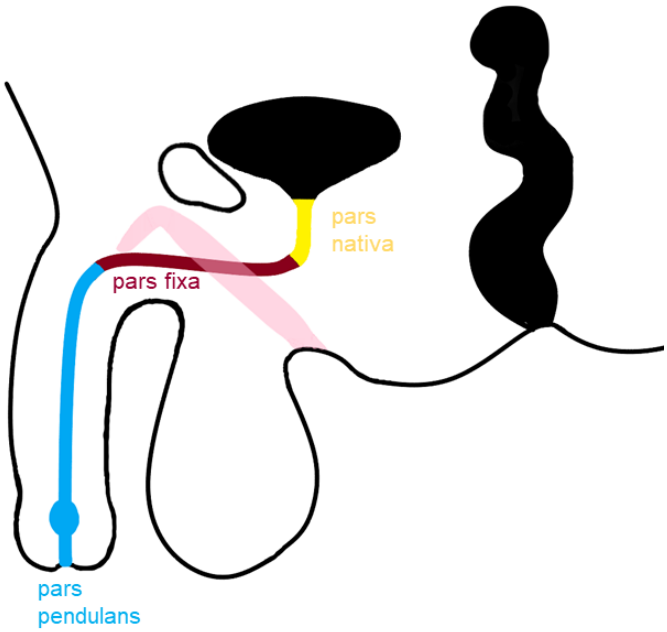

Figure 3. The urethra in born-female individuals undergoing phalloplasty, is composed of three parts: (1) the native female urethra (*yellow*); (2) the pars fixa of the urethra (*red*), requiring tubularization of the urethral plate; and (3) the pars pendulans of the urethra (*blue*), which is a part of the phalloplasty-design. The final position of the clitoris is shown in pink.

Several techniques are available for constructing the fixed part of the urethra, involving the use of tissue flaps from the abdomen, labia minora, intestine, vagina, or bladder. The most common technique involves freeing and tubularizing the vestibular labia minora bilaterally, followed by using an additional layer of bulbospongiosus muscle to cover the urethroplasty suture line (60). This technique is virtually identical to the technique performed in metoidioplasty for reconstructing the proximal urethra.

The construction technique of the pars pendulans urethra, which is the urethral part located in the neophallic shaft, depends on the phalloplasty design carried out by the surgeon (28) (Figure 3). The tube-in-tube design provides the best results regarding urethroplasty, this technique is used in RFF phalloplasty and ALT phalloplasty in case of a thin subcutaneous tissue layer (47). All other techniques use an additional skin flap or graft for urethroplasty, usually a small RFF flap or a SCIAP flap (50,54) (Figure 2, p. 12). Once the construction of the pendulans urethra is completed, it will be surrounded with the tissue for the phallic shaft and the whole will be anastomosed to the fixed urethra.

Regardless of which skin flap is used, a large scar will remain at the donor site, although the donor area may be chosen in such a way as to prevent obvious scarring (48). Secondary, urethral strictures and fistulas are common urethral following phalloplasty (47,50,51). Additionally, some other complications may arise, both at the level of the donor site and the level of the neophallus and neourethra, including complete or partial phallic loss, infections, hematoma, wound dehiscence, wound healing problems, post-void dribble, and other LUTS, a higher prevalence of kidney stones, and urinary infections (41,47,49–51).

Despite the complications, phalloplasty provides an aesthetically male-like neophallus of acceptable length, enabling the individual to void while standing in social circumstances and to participate in penetrative sexual intercourse in most cases. In addition, erogenous and tactile sensations are mostly preserved following phalloplasty. The biggest drawbacks are the scar at the donor site and the high urologic complication rate (28,41,48,50,51,53).

1.3.2.5 Scrotoplasty

The creation of a neo-scrotum is usually performed in a single-stage procedure combined with metoidioplasty or phalloplasty (38). The labia majora and the scrotum are embryologic analogs, making the labia an ideal choice for scrotoplasty. To create a neo-scrotum in front of the legs, the labia majora are semi-circumferentially incised dorsally and turned 180 degrees to the top of the penoscrotal angle or transposed using a V-Y plasty (28). Complications following this procedure include wound healing problems and wound dehiscence. (28,42)

1.3.2.6 Secondary masculinizing genital surgeries

Some gender dysphoric individuals may opt for additional masculinizing gGAS procedures in a second stage after metoidioplasty or phalloplasty.

The construction of the penile glans in phalloplasty is usually achieved using the Norfolk technique. The surgeon elevates a distal circumferential portion of the neophallus and rolls it over to create the corona, and a skin graft serves to cover the defect on the shaft (19,41). The individual can opt to tattoo the glans two to three months following primary gGAS, before sensations return to the penis, for a more reliable color of the glans (41,51).

Prosthesis placement is another second-stage option. After a minimum of twelve months following primary surgery, or when all possible complications are treated and tactile sensation returned, prosthesis placement may be considered. The individual can opt for testicular prostheses placement in the neo-scrotum and/or erectile prosthesis placement in case of phalloplasty (28). During the latter, a malleable or inflatable cylinder is placed in the neophallus, allowing the individual to mimic an erection (28,38,51). However, there is a high rate of revision surgery following these implants as a result of infections, erosions, malfunction, and malpositioning. This is due to the relative hypovascularity in the neophallus compared with the native penis, and the absence of tunica albuginea for prostheses fixation (28,38,51).

1.4 Non-classical genital affirmation surgery in gender dysphoric individuals

The traditional binary model for GAS, which focuses on creating either male or female anatomy, may not fully meet all individuals' needs (7,61). Preferred treatments for individuals seeking an adapted gender-affirming trajectory are under-investigated, as most studies focus solely on surgical techniques and clinical outcomes, rather than on the specific surgical preferences and needs of these individuals (4,7,62).

Requests for non-classical medical interventions such as hormone therapy, fGAS, top surgery, and gGAS have increased due to an increase in surgical techniques, more individualized approaches, and a different model of shared decision-making (19).

This thesis primarily focuses on de-feminizing and masculinizing gGAS in born-female transgender and gender diverse individuals, which are considered as non-classical procedures. Classical masculinizing procedures were defined as either a phalloplasty or a metoidioplasty including all the following steps: hysterectomy, total vaginectomy, perineal reconstruction, flap transfer (phalloplasty), or clitoral release (metoidioplasty), urethral

reconstruction and lengthening, and scrotoplasty. All surgeries not involving one of the above procedures can be defined as ‘non-classical’ and could either be seen as an endpoint in which not all feminine genital features are removed, or as the full removal of all feminine genital features, with or without reconstruction of all cross-gender features. In addition to fertility preservation before starting hormone treatment, some individuals choose to preserve their ovaries to remain fertile. However, this is not considered as a non-classical component of gGAS. Whether or not testicular or erectile prostheses were implanted is also beyond the scope of this thesis as it will only focus on the first-stage gGAS procedures.

Non-classical procedures and applications may arise for various reasons. Primarily, when an individual’s gender identity is not in line with the expected results of classical surgery, they may not only request non-classical surgery to align their body with the desired gender but also to be able to function as the desired gender does (4,7,61,63). For gender-diverse individuals, the process of gender transition may be more intricate or misunderstood by healthcare providers, requiring a unique and personalized approach (7,64,65). Even though most gender-diverse individuals are not (yet) applying for GAS, there is an increasing number of individuals doing so (4). A study by Jacobsson et al. (66) (2017) reported statistically significant differences regarding motivation for masculinizing surgery between gender-diverse individuals and trans-males, with born-female gender-diverse individuals reporting placing less value on a vaginectomy and male-appearing neophallus than trans male individuals. Moreover, a study by Hu et al. (7) reported a significantly lower incidence of gender-diverse individuals born-female requesting gGAS in comparison with individuals born-male doing so. Both studies emphasize the importance of an individual approach to determine an individual’s aims and requirements before any GAS is performed (7,66).

Other specific underlying motives for requesting procedures deviating from the classical procedure are the preservation of fertility and the possibility of pregnancy, fear/concerns of complications associated with classical surgery, sexual gratification, because previous genital surgery precludes a classical approach, age-related considerations (some individuals consider themselves too old for some interventions) (4), or a combination of mentioned reasons (30,32,64). On the other hand, the surgeon may advise against certain components due to contraindications or pre-operative (urologic) problems or may have a preference for a procedure that is not considered classical (4).

Born-female gender dysphoric individuals may opt for masculinizing surgery without urethral lengthening. They can either choose for perineal urethrostomy, where the urethral meatus is placed behind the neo-scrotum, or leave the urethral meatus at its original position. This option avoids the high risk of urethral complications, however, individuals will not be able to

void in a standing position. As a result, standing urination may not be a priority for those who opt for gGAS without urethral extension. Additionally, a pre-operative poor urinary function may discourage some individuals from choosing gGAS with urethral lengthening.

Furthermore, gender dysphoric individuals born-female may have a desire for masculinizing gGAS with vaginal retention, also referred to as zero-depth or partial vaginoplasty (27). In this case, a small opening is left at the level of the perineum to allow for the evacuation of vaginal secretions (21,28). This type of procedure involves the creation of the external male genitals without the resection of a vaginal cavity (27). This option avoids the risk of hemorrhage, life-long dilatation, and other risks related to this type of vaginectomy. Besides, some individuals might have the desire to retain their vagina for sexual gratification or future reproduction (27,33,35,59). In some centers, according to the protocol or surgeon's preferences, only a partial vaginectomy is performed.

The reasons and effects of not performing a scrotoplasty in gender dysphoric individuals have poorly been described in the literature. An exception is a study by Noe et al. (33), where no scrotoplasty is performed but testicular prostheses are placed inside the untouched labia majora.

Non-classical gGAS is a component of surgeries in TGD individuals that has not yet been extensively studied. The motives for choosing surgery deviating from classical procedures can vary and may be influenced by either the individual or their healthcare provider.

1.5 Problem statement and main objective

Genital gender-affirming surgery has been performed at the Ghent University Hospital for over 30 years. In the last five years, the number of requests for non-classical gGAS has risen considerably (Appendix 5). Even though the demand for this type of surgery has increased, little research has yet been conducted regarding tailored treatment and approaches to individuals requesting such.

The main objective of this thesis is to investigate whether an individualized approach, tailored to the specific needs of the individual, leads to improved results. (i) Firstly, this thesis aims to provide a detailed description of the clinical outcomes that result from the different types of masculinizing non-classical gGAS, performed at the Ghent University Hospital, with a particular emphasis on identifying and characterizing any complications that arise or the lack thereof due to less invasive surgery. All complications were recorded and described in detail, specifically focusing on urethral complications rate, their site of occurrence, any need for revision surgery, and the type of revision surgery performed. (ii) Secondly, the underlying

motives for a non-classical treatment request are explored, taking into account factors such as gender diverse gender identity, the influence of healthcare providers and their explanation towards the health-seeking individual, age of the individual, the role of having a partner, and the role of sexual preference of the individual. (iii) Finally, the thesis aims to evaluate individuals' satisfaction, not only focusing on overall satisfaction but also on satisfaction with aesthetic appearance, voiding function, and sexual function. By assessing these factors, we aim to improve the understanding of non-classical treatment requests, enhance patient care, and provide valuable insight for healthcare providers.

2. Methodology

This thesis reports on a retrospective cohort analysis that reviews data from all non-classical masculinizing gGAS procedures performed in the specialized center for gender at the Ghent University Hospital over the past 17 years (January 2006 until June 2023) (N = 69). A subset of patients who underwent non-classical masculinizing gGAS was identified and analyzed separately.

2.1 Study design

Two separate retrospective databases were created, incorporating data of all born-female individuals who underwent either a non-classical metoidioplasty or a phalloplasty at our center between January 2006 and February 2023. The local ethical committee approved this study before its commencement (BC-11695).

In this thesis, the focus was laid on born-female individuals who had undergone gGAS outside of the 'classical' procedures. Classical masculinizing procedures were defined as either a phalloplasty or a metoidioplasty including all the following steps: total vaginectomy, perineal reconstruction, flap transfer (phalloplasty), or clitoral release (metoidioplasty), urethral reconstruction and lengthening, and scrotoplasty. All individuals who underwent surgery not involving one of the above procedures were eligible for inclusion in this series.

Operation reports were checked for preoperative patient characteristics, intraoperative and perioperative data, motivation for non-classical surgery, postoperative data and complications, and patient satisfaction functionally, aesthetically, and sexually.

The length of hospital stay was calculated from the day of the surgery to the day of discharge-related to the primary masculinizing surgery. Duration of catheterization was calculated separately for suprapubic and transurethral catheters, starting from the day of surgery. Perioperative complications were defined as any complication requiring revision surgery during the first 15 days following initial surgery. Postoperative complications within 90 days were scored using the Clavien-Dindo classification (67). Urethral complications were evaluated during every postoperative visit.

This retrospective cohort study was written according to the STROBE guidelines (68).

2.2 Study population

All transgender and nonbinary born-female individuals who have had genital surgery at Ghent University Hospital from the beginning of January 2006 until February 2023, were

considered for inclusion. Individuals whose primary masculinizing surgery was classified as non-classical were included. Individuals with a follow-up less than six months were included in the study, however, postoperative complications and satisfaction in these individuals were not reported as the follow-up period was too short. This thesis focuses solely on primary masculinizing surgeries, revision surgery following primary procedures will be extensively investigated though, as they have an impact on the functional outcome and satisfaction postoperatively. Secondary masculinizing surgeries are not within the scope of this thesis. Furthermore, one individual underwent a prior phalloplasty at another hospital and was therefore excluded.

At Ghent University Hospital, a diagnosis of gender dysphoria is made following the WPATH guidelines (69). Once the diagnosis is confirmed and extensive counseling has been given about hormonal treatment and gGAS, the individual might choose to start hormonal treatment, whether or not followed by gGAS at least one year following the start of hormonal treatment if desired.

Preoperative counseling for individuals opting for gGAS at our center includes urologic assessment, as preexisting lower urinary tract disorders (LUTS) might worsen after urethral lengthening. Uroflowmetry and ultrasonography of the kidneys and bladder are performed to exclude any lower or upper tract anomalies. In individuals with aberrant urinary function pre-operatively, pre-operative pelvic floor physiotherapy is recommended to prevent urethral complications. Moreover, all individuals receive comprehensive information on the various types of gGAS, and extensive discussions regarding expectations about voiding function, urethral and non-urethral complications, aesthetic results, and the possible need for revision surgery are held. Informed consent is necessary if the individual desires future gGAS.

2.3 Procedures

Treatment requests were systemically collected during the assessment. De-feminizing techniques are categorized as hysterectomy and complete vaginectomy; and masculinizing procedures either as phalloplasty or metoidioplasty combined with clitoral release, creation of a male-like perineum, urethral reconstruction and lengthening, and scrotoplasty. All individuals who underwent surgery not involving one of the above procedures, either as an endpoint in which not all feminine genital features are removed or as the full removal of all feminine genital features, with or without reconstruction of all cross-gender features, were considered eligible for inclusion in the dataset (Appendix 4).

Two different datasets were created, one with all individuals who underwent non-classical metoidioplasty and one with all individuals who underwent non-classical phalloplasty. Surgery specifications per individual were described in Appendix 2 and 3.

2.4 Outcome

Primarily, this thesis focuses on the rate of postoperative urethral complications, non-urethral complications, voiding function, and whether the choice of non-classical surgery was intended by the individual, a preference of the surgeon, or a result of shared decision-making. Potential predictors herein are preoperative active smoking, body mass index (BMI), concomitant vaginectomy and/or urethroplasty, medical history, and a pre-operative wish for voiding in a standing position.

Other outcomes that may be of interest within the framework of this thesis include individuals' satisfaction following surgery, pre- and postoperative sexual attraction and relation, the ability to maintain an erection, the sexual function of the neophallus, and the ability of the individual to achieve orgasms.

2.5 Statistical analysis

Statistical analyses were performed using the IBM Statistical Package for the Social Sciences (SPSS), version 29.0 for Windows. Descriptive statistics were used to evaluate demographic and outcome variables.

Continuous variables were evaluated for normality. All variables were evaluated for normality using the Shapiro-Wilk test, combined with an evaluation of descriptive statistics, histogram, boxplot, and Q-Q-plot. As none of the variables were normally distributed, results were all reported as median with interquartile range (IQR). The Mann-Whitney U test was utilized to compare continuous variables in this series. Categorical variables are reported as numbers with proportion and compared using the Chi-square or Fisher's exact test whenever appropriate, and the results were presented as mean, standard deviation (SD), median, minimum, and maximum. All tests were two-sided and a p-value of less than 0.05 was considered statistically significant.

3. Results

The results from this thesis are reported separately for a group of individuals who underwent metoidioplasty and phalloplasty. Firstly, the patient characteristics are discussed. Afterwards, the surgical techniques that were performed at Ghent University Hospital are mentioned. These are divided into de-feminizing and masculinizing techniques. Non-classical metoidioplasty and phalloplasty are analyzed and the resulting complications and satisfaction are reported. Finally, the underlying motives for non-classical gGAS are described

After reviewing patient records from 1 January 2006 to 31 July 2023, a total of 69 individuals were found eligible for inclusion in this analysis. Of these, 27 individuals opted for non-classical metoidioplasty (Table 1). The median age at the time of metoidioplasty was 26 years, and the median BMI was 23 kg/m². Twenty-six individuals described their gender as trans-male and one individual as genderfluid. The median follow-up time ensuing metoidioplasty, excluding individuals with less than six months follow-up, was 26 (12 – 52) months.

Furthermore, 42 individuals underwent non-classical phalloplasty in the study period (Table 2). The median age at the time of phalloplasty was 24 years and the median BMI was 25 kg/m². Information about BMI for one individual was missing. All individuals of the phalloplasty group defined their gender as trans-male. The median follow-up time ensuing phalloplasty, excluding individuals with less than six months follow-up, was 26 (14 – 56) months.

Medical history was assessed for each individual in both the metoidioplasty and the phalloplasty group, and reported if relevant. All individuals received hormones and underwent mastectomy and hysterectomy prior to metoidioplasty.

Table 1. Patient's characteristics metoidioplasty

	N = 27 (%)
Described gender	
Trans-male	26 (96.3)
Genderfluid	1 (3.7)
Nationality	
Belgian	22 (81.5)
Dutch	2 (7.4)
German	1 (3.7)
French	1 (3.7)
British	1 (3.7)
Active smoking	4 (14.8)
Medical history	
Cardial history	0
Pneumologic history	3 (11.1)
Asthma/COPD [1]	2
OSAS [2]	1
Auto-immune history	0
Diabetes mellitus type II	1 (3.7)
Other	3 (11.1)
Cerebral palsy (in wheelchair)	1
Myotonia congenita	1
Ehler-Danlos syndrome	1
Testosterone use	27 (100)
Mastectomy prior to metoidioplasty	27 (100)
Hysterectomy prior to metoidioplasty	27 (100)
	Median (IQR[3])
Age at primary surgery (years) (n = 27)	26 (23 – 37)
Body mass index (kg/L²) (n = 27)	23 (22 – 27)
Start testosterone intake prior to surgery (months) (n = 25)	34 (27 – 48)
Mastectomy prior to surgery (months) (n = 27)	30 (19 – 41)
Hysterectomy prior to surgery (months) (n = 26)	18 (10 – 25)
Follow-up (months) (n = 21)	26 (12 – 52)

[1] COPD = chronic obstructive pulmonary disease
[2] OSAS = obstructive sleep apnea syndrome
[3] IQR = interquartile range

Table 2. Patient's characteristics phalloplasty

	N = 42 (%)
Described gender	
Trans-male	42 (100)
Nationality	
Belgian	27 (64.3)
Dutch	4 (9.5)
French	1 (2.4)
British	2 (4.8)
Danish	3 (7.1)
Italian	3 (7.1)
Nordish	1 (2.4)
Spanish	1 (2.4)
Active smoking	10 (23.8)
Medical history	
Cardial history – hyperkinetic heart	1 (2.4)
Pneumologic history - OSAS [1]	1 (2.4)
Auto-immune history – MS [2]	1 (2.4)
Diabetes mellitus type II	2 (4.8)
Ehler-Danlos syndrome	1 (2.4)
Testosterone use	42 (100)
Mastectomy prior to phalloplasty	42 (100)
Hysterectomy prior to phalloplasty	42 (100)
	Median (IQR[3])
Age at primary surgery (years) (n = 42)	24 (21 – 38)
Body mass index (kg/M²) (n = 41)	25 (22 – 28)
Start testosterone intake prior to surgery (months) (n = 40)	49 (32 – 83)
Mastectomy prior to surgery (months) (n = 41)	43 (25 – 66)
Hysterectomy prior to surgery (months) (n = 42)	29 (17 – 58)
Follow-up (months) (n = 38)	26 (14 – 56)

[1] COPD = chronic obstructive pulmonary disease
[2] OSAS = obstructive sleep apnea syndrome
[3] IQR = interquartile range

3.1 De-feminizing procedures for metoidioplasty and phalloplasty

The first step in gGAS surgery are de-feminizing procedures. All individuals included in this series received hysterectomy prior to metoidioplasty (Table 3 and Table 4). This was performed at a median of 18 (10 – 25) months before metoidioplasty and 29 (17 – 58) months before phalloplasty. In five individuals from the metoidioplasty group, hysterectomy and metoidioplasty were performed in the same procedure, this did happen in none of the phalloplasty individuals. Regarding the fate of the vagina, three possible approaches were employed at the Ghent University Hospital among the individuals included in this thesis. The first option was complete vaginectomy (n = 34), involving total submucosal dissection and fulguration of the distal hysterectomy scar. First of all, the posterior vaginal-rectal plane is released by blunt dissection, which is followed by combined sharp and blunt dissection of the anterior plane and eventually by dissection of the lateral walls. The vaginal introitus is then closed from anterior to posterior. A second option was partial vaginectomy (n = 24), in which the mucosa of the distal vaginal canal is dissected whilst the upper part of the vaginal canal remains untouched. An opening in the vagina introitus remains and a drain is placed in the vaginal space for evacuation of vaginal discharge. This procedure of partial vaginectomy was implemented by default in our center between 24/06/2016 and 20/11/2018. Vaginectomy procedures were always performed during primary metoidioplasty or phalloplasty surgery. A detailed description of both complete and partial vaginectomy techniques in our center is given by Lumen et al. (28). The third option was complete vaginal preservation (n = 11), herein the vaginal canal is left intact and the vaginal introitus remains untouched. All 12 individuals from the metoidioplasty group and 23 individuals from the phalloplasty group who did not undergo complete vaginectomy were described in this thesis.

Table 3. De-feminizing procedures following metoidioplasty

	N = 27 (%)
Hysterectomy	27 (100)
Vaginectomy	
None	7 (25.9)
Partial	5 (18.5)
Complete	15 (55.6)

Table 4. De-feminizing procedures following phalloplasty

	N = 42 (%)
Hysterectomy	42 (100)
Vaginectomy	
None	4 (9.5)
Partial	19 (45.2)
Complete	19 (45.2)

The handling of the clitoris differs slightly for metoidioplasty and phalloplasty. While the hormonally enlarged clitoris will form the base of the phallus in metoidioplasty, it will be buried under the base of the phallus after fixation to the pubic bone in phalloplasty.

3.2 Masculinizing procedures in metoidioplasty

The next step in gGAS are the masculinizing procedures. In metoidioplasty, the hormonally enhanced clitoris is denuded and subsequently released from its attachment with the perineum, after which it is lifted and stretched to form the base of the phallus. Clitoral release can be performed dorsally by releasing the suspensory ligament to the pubic symphysis, or ventrally by splitting the ventral vestibular plate and ventral angulating ligaments. In this series, a combination of both ventral and clitoral release was the most performed technique (n = 20) (Table 5), although some surgeries involved only ventral release (n = 3), only dorsal clitoral release (n = 2), or no clitoral release at all (n = 2).

Table 5. Masculinizing procedures following metoidioplasty

	N = 27 (%)
Clitoral release	
None	2 (7.4)
Ventral only	3 (11.1)
Dorsal only	2 (7.4)
Ventral and dorsal	20 (74.1)
Urethroplasty	
None	19 (77.8)
Tubularization only	2 (7.4)
Tubularization + AUL[1]	6 (22.2)
Scrotoplasty	
Anteriorization alone	16 (59.3)
Posteriorization alone	0
Anteriorization + posteriorization	10 (37.0)
Missing system	1 (3.7)

[1] Additional urethral lengthening

For the management of the urethra in metoidioplasty, three possible approaches are performed in our center. The first approach entails the creation of the proximal urethra (Figure 1, p. 8) by primary tubularization of the vestibular urethral plate (n = 2). A 3-cm wide vestibular urethral plate in the plane between the female meatus and the glans clitoris is created using the inner side of the labia minora. In this approach, no splitting of the vestibular plate is necessitated, so only dorsal clitoral release is performed. Secondarily, individuals may opt for AUL on top of primary tubularization (n = 6). In our center this is carried out by distal splitting of the vestibular urethral plate, followed by tubularization of a transverse preputial skin island flap that is connected end-to-end to the proximal urethra, thus creating the distal urethra (Figure 4). Thirdly, individuals can decide to perform metoidioplasty without urethral lengthening (n = 19). In this case, the meatus either remains untouched, located at the anatomic female position, or a perineostomy is created in which the meatus is placed behind the scrotum, also often referred to as perineal urethrostomy. In total, 19 individuals were described in this thesis because they underwent metoidioplasty without urethral lengthening (Table 5). A perineostomy was created in 17 individuals, and the meatus was left at the anatomic female position in two individuals. To ensure recovery of micturition postoperatively, catheterization is important. In individuals who underwent urethral lengthening, both a transurethral catheter (TUC) and a suprapubic catheter (SPC) were placed, whereas solely a TUC was placed in individuals who did not opt for urethral lengthening in most cases. The TUC is removed after a few days enabling the individual to

void. In individuals who opted for urethral lengthening, the SPC is left in place until normal voiding function is acquired.

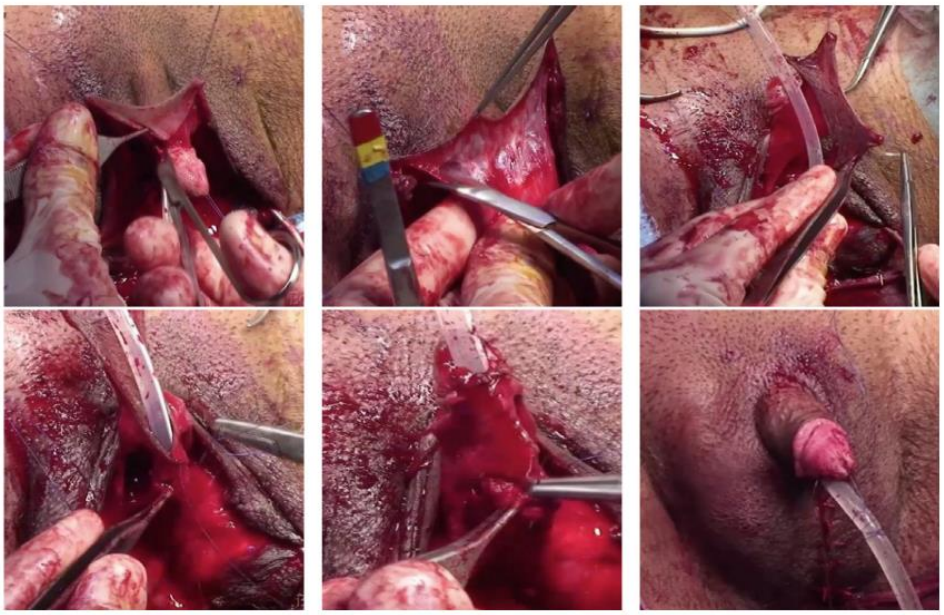

Figure 4. Technique of additional urethral lengthening with transverse preputial skin island flap. Preputial skin is incised just below the corona of the clitoridial glans and a width of 2.5cm is respected (upper left). The flap is mobilized by subcutaneous dissection respecting the dartos layer which is the pedicle of the flap (upper mid). The transverse flap is transposed ventrally to the neophallus (upper right). The flap is tubularized around a 16F urethral catheter (lower left). The tube is anastomosed to the proximal urethral part (lower mid). Final result after skin coverage (lower right).

Note. Adapted from "Urethral Complications After Metoidioplasty for Genital Gender Affirming Surgery.", by M. Waterschoot, P. Hoebeke, W. Verla, AF. Spinoit, M. Waterloos, C. Sinatti et al., 2021, *Journal of Sexual Medicine*, *18(7)*, p. 1273 (https://doi.org/10.1016/j.jsxm.2020.06.023). Copyright © International Society for Sexual Medicine 2021

The creation of the neo-scrotum is the next step in masculinizing procedures. All individuals included in this thesis underwent scrotoplasty. In our center, the most performed technique for scrotoplasty during metoidioplasty involves 180-degree anteriorization of the posterior labia majora. In the metoidioplasty group, 16 individuals underwent this type of scrotoplasty (Table 5). Recently, a newer technique has been performed in some individuals, involving a combination of anteriorization of the posterior labia, caudal transposition of the anterior labia, and a prepubic total mons fat prelevation, resulting in three flaps. These flaps are used for the construction of the scrotum. Part of this prepubic skin bridge is used for scrotal filling as well. This last technique was described by Morrison et al. (43) and is a variation of the Ghent scrotoplasty that is used in phalloplasty procedures. This technique was carried out in 10 individuals who underwent non-classical metoidioplasty. For one individual, no report was made on which type of scrotoplasty was performed.

3.3 Surgical specifications and complications following metoidioplasty

A comprehensive assessment of surgery specifications was performed in all individuals who received non-classical metoidioplasty (Table 6). A detailed overview of surgical specifications and complications per individual can be found in Appendix 2.

The median operating time in individuals who did not receive concomitant surgery was 120 (91 – 140) minutes. No significant difference in operation time was reported between individuals receiving primary metoidioplasty with or without concomitant surgery (p = 0.632). The median stay in the hospital following metoidioplasty was four (4 – 6) days. Perioperatively, six individuals received antibiotics other than the standard dose administered in the first 24 hours following surgery. Reasons for this were wound infection in one individual, gonorrhea infection in one individual, UTI in one individual, surinfection of a hematoma in one individual, perineal bleeding in one individual, and prolonged catheterization in one individual. One individual needed a perioperative blood transfusion. For three individuals, no data were available for perioperative blood transfusion, or antibiotic administration.

Duration of catheterization was assessed for most individuals, in 15 individuals solely TUC was performed following metoidioplasty, and eight individuals had TUC combined with SPC placement. The duration of TUC was not significantly prolonged in the group with solely TUC in comparison with the group in which TUC placement was combined with SPC placement (p = 0.089). Additionally, perioperative anticholinergic use was assessed in 24 individuals. Individuals were advised to use this medication in case of bladder spasms. No significant difference in dosage or duration of use was seen between individuals with either only TUC placement or TUC and SPC placement combined (p = 0.289).

Table 6. Surgical specifications and peri-operative[1] outcomes following metoidioplasty

	N = 27 (%)
Intraoperative complication	0
Concomitant surgery	8 (29.6)
Correction mammectomy	5
Hysterectomy	3
Perioperative[2] antibiotics	6 (22.2)
Perioperative blood transfusion	1 (3.7)
Perioperative revision surgery	3 (11.1)
Hematoma drainage	2
Replacement suprapubic catheter	1
	Median (IQR)
Operating time (minutes)	
No concomitant surgery (n = 19)	120 (91 – 140)
Concomitant surgery (n = 8)	123 (103 – 137)
Hospital stay (days) (n = 27)	4 (4 – 6)
Catheter duration (days)	
Transurethral catheter (n = 22)	10 (10 – 16)
Suprapubic catheter (n = 10)	11 (7 – 18)

[1] Perioperative is defined as the first 15 days following the initial surgery, or if the hospitalization period was longer than 15 days, the entire period of hospitalization

[2] Antibiotics longer than first 24h

Surgical specifications were compared between a group of individuals who received no or partial vaginectomy (n = 15) during primary metoidioplasty and one who received complete vaginectomy (n = 12). No significant differences are found for operating time (p = 0.379), duration of hospital stay (p = 0.573), perioperative antibiotic intake (p = 0.115), perioperative revision surgery (p = 0.231), and duration of catheterization (p = 0.395 for TUC and p = 0.674 for SPC). The same was performed for a group of individuals who received no urethral lengthening (n = 19) during primary metoidioplasty and a group in which urethral lengthening (n = 8) was performed. A significantly higher intake of perioperative antibiotics was reported in the urethroplasty group (37.5 % vs 15.8%, p = 0.003). No significant differences were found for operating time (p = 0.595), duration of hospital stay (p = 0.028), perioperative revision surgery (p = 0.532), and duration of catheterization (p = 0.027 for TUC and p = 0.334 for SPC).

Table 7. Follow-up period metoidioplasty

	N = 21 (%)
Postoperative complications (Clavien Dindo <90 days)	
GI	5 (23.8)
GII	9 (57.1)
GIIIa	1 (4.8)
GIIIb	2 (9.5)
GIVa	1 (4.8)
Urethral fistula	5 (23.8)
Conservative treatment	0
Surgical treatment	5
Urethral stricture	7 (33.3)
Conservative treatment	2
Intermittent self-dilatation	0
DVIU or Otis	0
Urethroplasty	3
Permanent perineostomy	0
Revision perineostomy	2
Revision surgery other than for stricture or fistula	5 (23.8)
Revision perineostomy	2
Scrotoplasty following scrotal dehiscention	1
Removal vaginal rest	1
Revision scrotoplasty	1
Final position meatus	
Along penile shaft	3 (14.3)
Perineal	15 (71.4)
Penoscrotal	1 (4.8)
Unknown	2 (9.5)
Able to void while standing	
No, but not intended	15 (71.4)
No, was initially intended	3 (14.3)
Yes	1 (4.8)
Unknown	2 (9.5)
Secondary gGAS surgeries	
Phalloplasty	4 (19.0)
Testicular prostheses	5 (23.8)

The postoperative outcomes of 21 individuals who received non-classical metoidioplasty are summarized in Table 7. A minimum of six months follow-up was set ensuring the assessment of most postoperative events and adequate reports of outcome on gGAS. Urethral fistulas occurred in five individuals, all of which received AUL. Fistulas were located distal penile in one individual, proximal penile in one individual, penoscrotal in one individual, and urethrovaginal in two individuals. Excision was necessary in all cases, and in one individual, concomitant secondary vaginectomy was performed. Urethral strictures occurred in six individuals following metoidioplasty. In two individuals who received primary tubularization, a meatal stricture occurred. Three individuals that underwent AUL had a stricture postoperatively, being located at the distal urethra in one individual, and at the anastomosis of the native and proximal urethra in two individuals. Lastly, a perineal stricture

occurred in two individuals who did not undergo urethral lengthening at all. In three individuals, revision surgery was necessary to treat the urethral stricture. Five individuals underwent revision surgery for reasons other than urethral fistulas or strictures. In one of these, VY-scrotoplasty was performed for aesthetic improvement of the neo-scrotum, after the formation of penoscrotal webbing of scrotal skin onto the ventral penile shaft. For two individuals, no data was available on whether or not revision surgery was necessary. In four individuals, phalloplasty was performed in a later stage, and one individual initially intended metoidioplasty to be a step-up procedure for phalloplasty but did not undergo phalloplasty up until now.

When comparing a no/partial vaginectomy group (n = 11) with a complete vaginectomy group (n = 10), no significant results were found for Clavien Dindo classification (p = 0.557), fistula formation (p = 0.035), urethral stricture occurrence (p = 0.361) or revision surgeries other than for urethral complications (p = 1). When comparing a no urethral lengthening group (n = 12) with a urethroplasty group (n = 7), fistula formation occurred significantly more in the urethroplasty group (0% versus 62.5% p = 0.003). No significant results were found for Clavien Dindo classification (p = 0.663), urethral stricture occurrence (p = 0.056), or revision surgeries postoperatively (p = 0.670).

3.4 Patient-reported outcomes and satisfaction following metoidioplasty

Patient-reported outcomes and satisfaction following metoidioplasty were only reported in a minority of individuals (Table 8). Of all 21 individuals, 11 individuals specifically reported overall, functional, and/or aesthetical satisfaction and one individual reported functional satisfaction but was not satisfied with the aesthetic outcome, desiring future revision surgery. One individual reported dissatisfaction with both the functional outcome and the partial vaginectomy because complete vaginal preservation was intended. Satisfaction and

Table 8. Patient-reported outcome and satisfaction following metoidioplasty

	N = 21 (%)
Orgasm with masturbation possible	
Not possible	2 (9.5)
Less intensity as pre-operatively	2 (9.5)
Same intensity as pre-operatively	4 (19.0)
More intense as pre-operatively	1 (4.8)
Unknown	12 (57.1)
Orgasm with sexual interaction possible	0
Most sensitive genital zone	
Tip of phallus	1 (4.8)
Penile shaft	1 (4.8)
Vaginal	1 (4.8)
Unknown	18 (85.7)
	Median (IQR)
Aesthetic satisfaction score on 100 (n = 1)	70
Functional satisfaction score on 100 (n = 3)	70
Overall score on 100 (n = 3)	85 (75 – 90)
Length of phallus (cm) (n = 1)	11.5

dissatisfaction were not specifically questioned by any individual. Furthermore, increased attention was paid to sexual function postoperatively in the last few years. These results were assessed in some individuals, however, for the majority of individuals, no data was available.

3.5 Masculinizing procedures phalloplasty

First of all, the clitoris is denuded and fixated to the pubic bone along with one of the clitoral nerves. These will be buried under the base of the neophallus. For the construction of the neophallus during phalloplasty, a vascularized skin flap is used. In our center, the radial free forearm (RFF), the anterolateral thigh (ALT), and the superficial circumflex iliac artery perforator (SCIAP) flaps are the different types of flaps used.

For the management of the urethra in phalloplasty, two possible approaches are performed in our center. The first approach entails complete urethral lengthening, in which both the fixed urethra and the pars pendulans are constructed (see Figure 3, p. 11). The fixed part is constructed similarly to the technique described for metoidioplasty, by tubularization of the vestibular urethral plate. This part of the urethra is fixated on the pubic bone along with the clitoris, awaiting anastomosis of the phallus. The pars pendulans urethra is constructed either by a tube-in-tube flap design of the phallus or by using an additional urethral skin flap. This urethral flap is harvested from the RFF, ALT, or SCIAP region depending on which donor site is used for phallus reconstruction. Both parts of the urethra are anastomosed and covered by the outer, phallic, flap. The second approach is not to perform urethral lengthening, either by choosing for perineostomy or by choosing to leave the meatus at the anatomic female position. Perineostomy is performed by connection of the urethra to the perineum. In this series, 19 individuals underwent phalloplasty without urethral lengthening, of which one opted for a meatus at the anatomic female position and 18 opted for perineostomy (Table 9).

Table 9. Masculinizing procedures following metoidioplasty

	N = 42 (%)
Phalloplasty	
Timing	
Primary	39 (92.9)
Following metoidioplasty	3 (7.1)
Type of flap for outer phallus	
RFF flap	19 (45.2)
ALT flap	18 (42.9)
SCIAP flap	5 (11.9)
Urethroplasty	
None	1 (2.4)
Perineostomy	18 (42.9)
Complete	23 (54.8)
RFF urethra flap	14
SCIAP urethra flap	6
Scrotoplasty	42 (100)
Synchronus anteriorization and posteriorization	40
Metachronus anteriorization and posteriorization	2

Scrotoplasty was performed in all individuals who underwent phalloplasty in this series. The scrotoplasty technique in phalloplasty is dependent on whether metoidioplasty was performed prior to phalloplasty or not. In primary phalloplasty procedures, scrotoplasty is carried out by synchronous 180-degree anteriorization of the caudal labia majora and posteriorization of the cranial labia majora. On the other hand, if phalloplasty is a step-up procedure following metoidioplasty, anteriorization is already carried out during metoidioplasty, and only posteriorization is performed during phalloplasty.

3.6 Surgical specifications and complications following phalloplasty

An assessment of surgery specifications of the 42 individuals who underwent non-classical phalloplasty is given in Table 10. A detailed overview of specifications per individual can be found in Appendix 3. In three individuals, step-up metoidioplasty was performed prior to phalloplasty, and 39 individuals intended primary phalloplasty. One individual who first opted for metoidioplasty did not intend future phalloplasty but was not satisfied with the result of metoidioplasty. Intraoperative complications occurred in 10 individuals during phalloplasty. Complications included insufficient perfusion of the flap by the main perforator vessels after isolation of the flap, resulting in a delay of the procedure of a few days in three individuals. Moreover, bladder perforation was reported in one individual, perforation to the peritoneum during vaginectomy in one individual, and laceration of an artery in one individual necessitating connection of the deep inferior epigastric artery perforator (DIEP) vessels. Other complications reported were transection of blood vessels from the right SCIAP flap, resulting in left SCIAP phalloplasty in one individual. a short length of the iliohypogastric nerve, necessitating secondary nerve anastomosis and an additional fasciocutaneus flap to reduce tension in one individual. In two individuals there was no doppler signal and a slow capillary refill of the phallus at the end of the surgery, which may have been a predictor for the complete venous

Table 10. Surgical specifications and peri-operative outcomes following phalloplasty

	N = 42 (%)
Intraoperative complications	10 (23.8)
Concomitant surgery	5 (11.9)
Correction mammectomy	4
Mucocele from metoidioplasty	1
Perioperative antibiotics	11 (26.2)
Perioperative blood transfusion	2 (4.8)
Perioperative revision surgery	12 (28.6)
Debridement necrotic tissue	5
Venous thrombosis (end-to-end closure)	4
Abscess drainage	1
Hematoma drainage	2
	Median (IQR)
Operating time (minutes)	
No concomitant surgery (n = 34)	385 (255 – 492)
Concomitant surgery (n = 5)	470 (330 – 533)
Delayed flap harvest (n = 3)	518 (415 – 621)
Hospital stay (days) (n = 42)	15 (9 – 18)
Catheter duration (days)	
Transurethral catheter (n = 39)	12 (11 – 15)
Suprapubic catheter (n = 20)	20 (15 – 29)

thrombosis of the phallus in one individual. In 11 individuals, antibiotics other than the standard dose administered in the first 24 hours following surgery, were administered. Reasons for this were abscess formation in one individual, of which the location was not specified; hematoma in the vaginectomy space in one, epidermolysis in one, complete necrosis of the phallic urethra in one individual, and surinfection in seven individuals, of which one individual developed a hemorrhagic shock, which was treated conservatively.

The median operating time was reported separately for surgeries with and without concomitant surgery. Operating time was not significantly longer in phalloplasty with concomitant surgery ($p = 0.266$). Furthermore, the median operating time was assessed for the individuals with a delayed procedure, this was 518 (415 – 621) minutes if the operating time of both surgeries were summed. Following phalloplasty, TUC was carried out in 19 individuals, whereas both TUC and SPC were carried out in 19 other individuals. Duration of TUC was not significantly prolonged in the group with solely TUC in comparison with the TUC combined with the SPC group ($p = 0.635$). Additionally, postoperative anticholinergic use was assessed in 38 individuals. There was no significantly higher use of anticholinergic medication in the group of individuals who received solely TUC in comparison with a group who received both TUC and SPC ($p = 0.195$).

Of the individuals who underwent phalloplasty, two major subgroups can be distinguished: those who did not undergo vaginectomy combined with urethral lengthening ($n = 23$) on the one hand, and those with complete vaginectomy without urethral lengthening ($n = 19$) on the other hand. Operating time was significantly longer in the first group (487 versus 255 minutes, $p < 0.001$), as was the duration of hospital stay in this group (17 versus 9 days, $p < 0.001$). Significantly more perioperative revisional surgery was necessary in this group as well (56.6% versus 10.5%, $p = 0.003$). There were no significant differences reported between the two groups for intraoperative complications ($p = 0.739$), need for perioperative blood transfusion ($p = 0.199$), perioperative antibiotics intake ($p = 0.502$), and duration of catheterization ($p = 0.093$ for TUC and 0.184 for SPC).

The postoperative outcomes of 38 individuals who received non-classical phalloplasty and had a follow-up time of at least six months are summarized in Table 11. Urethral fistulas occurred in 19 individuals, of which 17 underwent urethral lengthening and two individuals did not. Fistulas in individuals that underwent urethral lengthening were located at the phallic urethra in three individuals, the fixed part of the urethra in two individuals, at the anastomosis of the fixed and anatomic female urethra in four individuals, perineal in one individual, urethrovaginal in three individuals, on multiple locations in three individuals, and information on the location of the fistula was missing for one individual. For the two individuals who did

not undergo urethral lengthening, the fistula occurred at the anastomosis of the fixed and anatomic urethra in one individual, and information on the location was missing for one individual. Strictures occurred in 12 individuals, all of whom underwent urethral lengthening. The location of the stricture was meatal in three individuals, on the anastomosis of the pars fixa and the pars pendulans in five individuals, and the pars fixa in one individual. The location of stricture formation was unregistered in three individuals. Full necrosis of the phallic flap occurred in two individuals, necessitating vascularized flap covering. Full necrosis of the urethral flap occurred in three individuals, necessitating SCIAP flap coverage in one individual and STG coverage in two individuals. Partial urethral flap necrosis occurred in four individuals, in all individuals debridement of the necrotic tissue was performed, but no further revision surgery was carried out in the first place. Revision surgery other than for strictures or fistulas was performed in 25 individuals. In five of them, this was necessary for reasons of abscess drainage in one individual and revision following flap necrosis in four individuals. in the other 20 individuals, it was rather an aesthetic surgery to improve postoperative results (Table 11).

Postoperative outcomes of the group of individuals who did not undergo vaginectomy combined with urethral lengthening (n = 22) on the one hand, and those with complete vaginectomy without urethral lengthening (n = 16) on the other hand, were compared. Complications according to the Clavien Dindo classification during the first 90 postoperative days occurred

Table 11. Follow-up period phalloplasty

	N = 42 (%)
Postoperative complications (Clavien Dindo <90 days)	
GI	11 (28.9)
GII	6 (15.8)
GIIIa	0 (0)
GIIIb	21 (55.3)
Urethral fistula	19 (50.0)
Conservative treatment	2
Surgical treatment	16
Unknown	1
Urethral stricture	12 (31.6)
Conservative treatment	2
Intermittent self-dilatation	0
DVIU or Otis	2
Urethroplasty	3
Permanent perineostomy	2
Unknown	3
Flap necrosis	9 (10.5)
Partial necrosis phallic flap	0
Complete necrosis phallic flap	2
Partial necrosis urethral flap	4
Complete necrosis urethral flap	3
Revision surgery other than for stricture or fistula	25 (65.8)
Abcess drainage	1
Following flap necrosis	4
Revision scar contracture	4
Correction meatus	2
Secondary scrotoplasty	2
Lipofilling arm	3
Liposuction phallus (narrowing)	7
Correction centralization phallus	2
Final position meatus	
Along penile shaft	16 (42.1)
Perineal	18 (47.4)
Penoscrotal	2 (5.3)
Anatomic female	1 (2.6)
Unknown	1 (2.6)
Able to void while standing	
Yes	6 (15.8)
No, but not intended	16 (42.1)
No, was initially intended	7 (18.4)
Unknown	9 (23.7)

significantly more in the no vaginectomy/complete urethroplasty group (81.8% GIIIb complications versus 18.8%, p < 0.001). Furthermore, both fistula formation (77.3% versus 12.5%; p <0,001) and urethral strictures (54.5% versus 0%; p < 0.001) occurred significantly more in the first group. There was a significantly higher number of revision surgeries performed in the first group (90.9% versus 50.0%, p = 0.008). There were no significant differences reported for phallic flap-related complications (p = 0,066).

Table 11. Follow-up period phalloplasty (continued)

	N = 42 (%)
Secondary gGAS surgeries	
Coronaplasty	25 (65.8)
Erectile prosthesis	12 (31.6)
Testicular prostheses	14 (36.8)

3.7 Patient-reported outcomes and satisfaction following phalloplasty

Patient-reported outcomes and satisfaction following phalloplasty were only documented in a minority of individuals included in this thesis (Table 12). Of all 38 individuals, 14 individuals specifically reported overall, functional, and/or aesthetical satisfaction. On the other hand, six individuals reported any kind of regret or dissatisfaction post-operatively. Reasons given were partial vaginectomy when the individual requested complete vaginectomy in two of them, a desire for aesthetic revision of the phalloplasty that could not be fulfilled because an additional operation was too expensive for the individual, a scrotum correction that could not be performed because the urethra runs too close to the scrotum in one individual, and two individuals declared that a lack of pre-operative counseling was the reason for their dissatisfaction. One would not have opted for metoidioplasty prior to phalloplasty if the option of phalloplasty without urethral lengthening was given beforehand, and one individual would not have opted for gGAS at all if he had known the impact of complications following surgery. However, this last individual was satisfied with the result overall.

Table 12. Patient-reported outcomes and satisfaction following phalloplasty

	N = 38 (%)
Regret of surgery	6 (15.8)
Orgasm with masturbation possible	
Not possible	1 (2.6)
Less intensity as pre-operatively	3 (7.9)
Same intensity as pre-operatively	8 (21.1)
More intense as pre-operatively	2 (5.3)
Unknown	24 (63.2)
Orgasm with sexual interaction possible	0
Most sensitive genital zone	
Penoscrotal	9 (23.7)
Penile shaft right side	1 (2.6)
Unknown	28 (73.7)
	Median (IQR)
Aesthetic satisfaction score on 100 (n = 3)	82 (75 – 90)
Functional satisfaction score on 100 (n = 3)	72 (60 – 80)
Overall score on 100 (n = 7)	90 (75 – 100)
Length of phallus (cm) (n = 3)	12 (11 – 13)

3.8 Motives for non-classical treatment requests

Lastly, underlying motivations regarding non-classical surgery requests were analyzed in this thesis. In total, 12 individuals from the metoidioplasty group (33.3%) and 23 individuals from the phalloplasty group (54.8%) primarily did not opt for vaginectomy or only received removal of the distal vaginal mucosa (Table 13 and Table 14). In five of these individuals, this decision was made based on a contraindication prior to surgery, confronting these individuals at higher risk for complications during complete vaginectomy. Contraindications reported were the higher age in one individual, dysfunctional pre-operative urologic function, the occurrence of a vesicovaginal fistula following hysterectomy, gastro-intestinal history in one individual, which was not specified; and for one individual, no information was available on which contraindication was the reason for this choice. Nine individuals explicitly intended to preserve their vagina, with three individuals specifying that this was for sexual purposes, one specifically wished for a hidden vagina without further excision, and from five individuals no specific motivation was registered. Furthermore, in the period from 24/06/2016 and 20/11/2018, individuals were given the choice of either complete or partial vaginectomy. This was introduced because, prior to this period, serious complications, including rectal perforations and extreme bleeding, occurred in several patients as a result of complete vaginectomy. During this period, 21 individuals opted for partial vaginectomy. Because a higher ratio of urethrovaginal fistulas was observed following partial vaginectomy, this surgical approach was deserted after two years. In six individuals who primarily opted for this non-classical approach, complete vaginectomy in a secondary stage was performed anyway. This was performed as a treatment for urethrovaginal fistula formation in three individuals, during a secondary phalloplasty procedure following step-up metoidioplasty in one individual, due to vaginal fluid loss in one individual, and due to pain and a swollen feeling in the vaginal space in one individual. In this last individual, no report was made on mucocele formation.

On the other hand, urethral lengthening was not performed in 19 individuals from the metoidioplasty group (77.8%) and in 19 individuals from the phalloplasty group (45.2%) (Table 13 and Table 14). In five individuals, no urethral lengthening was performed due to pre-operative contraindications confronting these individuals at higher risk for urethral complications postoperatively. The request for gGAS without urethral lengthening was specifically intended by 32 individuals. The most common reasons reported were not having a wish for standing micturition in 11 individuals, and fear of complications in five individuals. Moreover, one individual only desired the aesthetic of a phallus without any further surgery, and one individual opted for this type of surgery to obtain maximal length gain during metoidioplasty. Theoretically, it can be assumed that there will be fewer scar tethering if no urethroplasty is performed, resulting in greater length gain of the phallus. However, no

results are yet available on this subject, so this suspicion must be treated with caution. In 14 individuals not performing urethral lengthening was intended by the individual, but no specified reason for their choice was recorded. In two individuals, metoidioplasty was performed as a step-up to phalloplasty later on. Only the proximal urethra was constructed during metoidioplasty, this was not seen as a non-classical approach. In one of these two individuals, urethral lengthening during phalloplasty was carried out and in one, future phalloplasty was not (yet) performed.

Table 13. Specific intention vaginectomy and urethral lengthening following metoidioplasty

	N = 27 (%)
Vaginectomy	
Not / only partially performed during primary metoidioplasty	12 (33.3)
Due to contraindications	2
Intention of the individual	5
Center's protocol / preference of surgeon	5
Complete vaginectomy performed during primary metoidioplasty	15 (55.6)
Complete vaginectomy performed in later stage	3 (11.1)
Due to complications	2
During secondary phalloplasty	1
Urethral lengthening	
Not performed	19 (77.8)
Due to contraindications	3
Intention of the individual	16
Complete urethral lengthening performed during primary metoidioplasty	6 (22.2)

Table 14. Specific intention vaginectomy and urethral lengthening following phalloplasty

	N = 42 (%)
Vaginectomy	
Not / only partially performed during primary phalloplasty	23 (54.8)
Due to contraindications	3
Intention of the individual	4
Center's protocol / preference of surgeon	16
Complete vaginectomy performed during primary phalloplasty	19 (45.2)
Complete vaginectomy performed in later stage due to complications	3 (7.1)
Urethral lengthening	
Not performed	19 (45.2)
Due to contraindications	2
Intention of the individual	16
Unknown	1
Complete urethral lengthening performed during primary phalloplasty	23 (54.8)

4. Discussion

As a result of social progress, the number of people applying for transgender and gender-diverse care has increased over the past years. This trend is accompanied by a higher incidence of gender dysphoric individuals seeking genital gender reassignment surgery (1,20,70).

In the masculinizing surgical treatment of gender dysphoric transgender and gender-diverse individuals, penile reconstruction poses a challenging issue. Not all patients are equally satisfied with the various available techniques for penile reconstruction (48,51). Ideally, surgeons should perform the reconstruction of the neopenis as a one-stage procedure that includes creating a competent neo-urethra, enabling the individual to void while standing and retain erogenous and tactile sensation, achieve enough bulkiness to insert a prosthetic stiffener (or be erectile itself) and achieve an aesthetically pleasing appearance, including the presence of a realistic neo-scrotum. Minimal scarring and no functional loss in the donor area should be achieved during this procedure (34,41,48,51). Furthermore, attention should be paid to the postoperative sexual satisfaction of individuals, as this is of great importance in a part of the TGD individuals opting for gGAS (4,61,66). Despite progressive developments, no current technique can meet all these requirements for the creation of a fully functional neophallus (56). Although current metoidioplasty and phalloplasty techniques intend to meet as many of the requirements for the creation of a fully functional neophallus as possible, none of them can meet all these requirements at once.

Besides these medical limitations, there is an increased request for surgeries that deviate from these classical, binary standard approaches (4,20). This is also seen in our center, especially for gGAS without urethral lengthening (See Appendix 5). Several developments have instigated this change in treatment approach, including societal changes, changes in general perceptions of gender, and a paradigm shift implying more patient-centered care (66). This shift is rooted partly in a range of individualized motives and needs of patients entering TGD care.

Within the current thesis, the focus was laid on surgical techniques and outcomes of individuals who opted for non-classical surgeries. The thesis provides an overview of non-classical masculinizing gGAS performed in born-female TGD individuals in one single-center from January 2006 up to June 2023. During this period, 69 individuals underwent non-classical surgery and were included in this retrospective analysis. Twenty-seven individuals underwent non-classical metoidioplasty-type procedures, and 42 non-classical phalloplasty-type ones. Data on these individuals were retrospectively collected through assessment of

the electronic patient files and reviewed. In both datasets, two subgroups emerged, one in which vaginectomy is not or is incompletely performed, and one in which urethral lengthening is not performed.

To our knowledge, this thesis is among the first evaluations of non-classical gGAS procedures. Therefore, the focus was laid primarily on describing techniques, reporting postoperative outcomes, patient's functional, aesthetical, and sexual satisfaction; and the underlying motivation.

4.1 Complications and satisfaction following non-classical gGAS

Regarding urethral complications, a statistically significant higher urethral complication rate is reported in the no/partial vaginectomy combined with the urethral lengthening group, both for metoidioplasty and for phalloplasty. Urethral lengthening, as expected, is associated with urethral complications. According to other studies, urethral fistula and stricture formation occur in 25-63% and 14-70% of cases respectively, and may require multiple revision surgeries (30,35,51,56,71–75). Strictures most frequently occur at the anastomosis between the proximal and the distal urethra (metoidioplasty) (35,38) or the fixed part and the pars pendulans of the urethra (phalloplasty) (74,75). These urethral complications are, evidently, not possible to occur when no urethral lengthening is performed, which implies that a reduction of urethral complications is expected if no urethral lengthening is performed (35,43,71,74). A study by Pigot et al. (71) reported on 68 individuals who did not receive urethral lengthening. A urinary complication rate of around 10% in individuals not opting for urethral lengthening was recorded in this study. This was in accordance with our findings, gGAS without urethral lengthening resulted in fewer fistula and stricture formation postoperatively (respectively 0% and 15.4% for metoidioplasty, and 12.5% and 0% for phalloplasty). Although urethral complications after perineostomy or scrotostomy may occur, their occurrence rate is rather low because of better coverage with local tissues at this location (51,61,76). No complications to the urogenital opening are mentioned in the series without urethral lengthening (61,76). In this series, two perineal strictures were reported in the metoidioplasty group and one perineal fistula was reported in the phalloplasty group.

It can be assumed that fewer urethral complications in the group who preferred no urethral lengthening, are associated with fewer secondary revision surgeries and outpatient hospital visits, which may have a positive effect on total healthcare costs in this population (71). The same accounts for complete vaginectomy, since this is expected that it is related to a lower rate of urethral complications. An additional advantage in individuals that do not opt for urethral lengthening, is that placing a suprapubic catheter is not necessary as the anatomic

position of the meatus is unchanged. In most individuals, only a transurethral catheter is placed, and this catheterization is easier (71). This prevents complications that may arise from suprapubic catheterization and is a contributing factor to fewer complications when not performing urethral lengthening (51,61,76). Urethral lengthening is also related to delayed wound healing of the phallus, implying longer hospitalization times (74).

Moreover, vaginal preservation may be a risk factor for urethral fistula formation, as stated in a study by Massie et al. (60) and Al-Tamimi et al. (30). They investigated complications following masculinizing gGAS and compared the results of a vaginectomy group and a vaginal preservation group. Massie et al. (60) reported a significantly higher occurrence of urethral fistulas in the vaginal preservation group (30 of 215 or 14% vs 5 of 9 or 56%), which was also confirmed by Al-Tamimi et al. who reported a higher occurrence of urethral fistulas in this group (48% vs 21%). A study by Waterschoot et al. (35) reported on urethral complications following metoidioplasty and did not identify vaginectomy as a protective factor for urethral complications, although the odds were in favor of concomitant vaginectomy when compared to a vaginal preservation group. These studies imply that this higher fistula rate may be attributed to the fact that no additional bulbospongiosus tissue is used in urethral lengthening in individuals choosing vaginal preservation (30,35,60). This well-vascularized bulbospongiosus tissue provides solid vascular support for this part of the urethra, thus preventing fistulae from developing (28,30,34,60). The significant reduction observed, especially in proximal/fixed urethral fistulas, cannot be explained solely by a learning curve (30). Furthermore, bulbospongiosus muscles can be used to evacuate the last drops of urine that stay in the urethra after micturition, reducing postvoid dribbling, which is a common phenomenon after gGAS surgery in born-female individuals (28). Contrarily, a study by Chesson et al. (77) described the effect of colpocleisis (partial vaginectomy) urethral lengthening and fistula development in transgender men. This study claimed that colpocleisis significantly decreased fistula formation. However, the study dates back to 1996, had a small sample size (n = 20), and fistulas occurred in 35%, which is higher than the reported fistula rate in other, more recent studies. Moreover, vaginectomy and hysterectomy were performed in the same procedure during this study, which may be an explanation for the higher complication rate in the complete vaginectomy group (31). A higher fistula occurrence is seen in the group with vaginal preservation and concomitant urethral lengthening in comparison with the complete vaginectomy and no urethral lengthening group. However, it is difficult to demonstrate an association between not performing complete vaginectomy on the one hand and the occurrence of urethral fistulas on the other in this thesis, since it is compared to a group in which no urethral lengthening is performed. Fistulectomy combined with secondary vaginectomy can be performed as a successful treatment in the case of

urethrovaginal fistulas (30). In three individuals within this thesis where vaginectomy was not performed primarily, complete vaginectomy in a secondary procedure was carried out for urethrovaginal fistula formation. Although the urethral complication rates found in our study correspond with rates reported in our study, it should be noted that smaller fistulas or meatal strictures that resolved spontaneously, were not always mentioned in the electronic patient register. As a result, there may be an underreporting of urethral complications in this thesis.

Complete vaginectomy is generally associated with surgical risks and complications. The findings in this thesis reflect that comparable complications occur in the case of partial vaginectomy as well. One intraoperative complication during phalloplasty could be linked back to vaginectomy directly, being a perforation to the peritoneum. Besides, in two individuals from the metoidioplasty group, perioperative revision surgery was necessary because complications following vaginectomy occurred, being surgical drainage of a hematoma and suturing an active uterine artery bleeding in one individual and venous occlusion because of a big hematoma, necessitating end-to-end vein closure in one. Both of these perioperative complications occurred in individuals who received partial vaginectomy. One could state from this that partial vaginectomy does not reduce the risk of perioperative complications. Moreover, extended operation time is to be expected in the complete vaginectomy group, as an additional procedure is performed. Although no significant differences were reported in intra-operative complications, perioperative revision surgery, and operation time, one must take into account the higher occurrence of complications when performing complete vaginectomy. A study with a larger sample size is necessary to confirm this. Other studies that assessed complications following vaginectomy report postoperative bleeding, bladder perforation, and rectum perforation (21,29,78).

Despite the sample size, the results of this thesis suggest that partial vaginectomy does not reduce the intra-, peri- and postoperative risk of complications. Moreover, postoperative discomfort does not decrease in this group compared to the no-vaginectomy group either. Also in terms of the occurrence of vaginal fistulas, no reduction was seen compared to the no vaginectomy group. Consequently, this surgical approach seems unnecessary to offer as an option. This has already been implemented in the Ghent University Hospital procedures since 2018.

Vaginal preservation may give rise to some inconveniences postoperatively, caused by persistent vaginal mucus production, complaints of discharge, and bad smell (31). Furthermore, vaginal pain postoperatively could be the result of a lack of estrogen, causing the vaginal mucosa to atrophy, but vaginal pain may as well be a result of bad vaginal hygiene in that particular individual (79). Two individuals included in this thesis requested

complete vaginectomy in a secondary procedure due to disturbing vaginal fluid loss, and due to pain and a swollen feeling in the vaginectomy loge.

Meanwhile, higher perioperative revision surgery rates in the vaginal preservation and urethral lengthening group may be partly explained by the fact that these surgeries were performed earlier, but cannot be explained solely by the learning curve of surgeons and the improvement of techniques.

Although a longer operating time may be expected in the urethral lengthening group, no significant difference was found between the two groups during metoidioplasty. This may be due to the low sample size of the urethroplasty group, but it could be assumed that urethral lengthening during metoidioplasty is not a time-consuming part of the procedure as well. For phalloplasty, a longer operation time in the urethral lengthening group is reported, this seems logical as the creation of the urethra on itself involves several additional actions.

A higher antibiotics administration following phalloplasty was reported in the complete vaginectomy and no urethroplasty group. Even though, a higher perioperative antibiotics administration is expected in the urethroplasty group because the additional urethra flap may cause dehiscence, necrosis, or infection.

A higher need for perioperative revision surgeries is seen in the no/partial vaginectomy and urethral lengthening group. Regarding perioperative revision surgery following phalloplasty, one must take into account that coronaplasty was performed in the perioperative period during the period from 16.06.2014 to 26.03.2018, according to the protocol at that time. In the patients who underwent phalloplasty thereafter, this no longer happened during the perioperative period but in a second staged surgery. Whether or not coronaplasty is performed shortly after the initial surgery may have an impact on the healing process of the neophallus, the occurrence of infections, and the hospitalization duration of the individual. On the other hand, it reduces the rate of second-stage surgery further down the trajectory. Even though, both for metoidioplasty and phalloplasty, perioperative revision surgeries were performed more frequently in this group, also if perioperative coronaplasty is not taken into account. Specific perioperative revision surgery due to urethral lengthening in this series was performed in five individuals with necrosis of the urethral flap, necessitating debridement. This implies a longer hospitalization in these individuals, as was seen in this series.

Postoperative revision surgery to counteract urethral complications, either fistulas or strictures, was performed in 15 out of the 23 individuals who underwent urethral lengthening. None of the revision surgeries for aesthetics, such as coronaplasty or scrotoplasty; nor these for skin contracture, were a direct consequence of urethral lengthening and therefore not reported here.

Subjective postoperative voiding function was not assessed in this series, and only limited objective urological outcomes, such as uroflowmetry and the ability to void in a standing position, were reported. These limited data are not sufficient to give an insight into voiding function and evaluation over time. Several reasons may account for this less thorough urological assessment postoperatively. First of all, individuals with an uncomplicated postoperative course were often seen less frequently during the follow-up period. Hence, no data are available from these individuals, although it can be assumed no abnormalities showed up, since they were inquired to come to the gender clinic in case of abnormalities. Secondarily, there were a significant number of individuals with a nationality other than Belgian, these often came from abroad to our gender clinic for treatment. In these individuals, follow-up often went partly remote, causing difficulties in interpreting results. A third reason for underreporting postoperatively may be the appearance of corona during the study period, non-urgent appointments were not possible during this period and certain individuals missed their follow-up appointments as a result.

Regarding the assessment of the voiding function, Pigot et al. (71) suggested that IPSS could be used to review the voiding function. Although this questionnaire is not yet validated for TGD individuals, it is the only one available for assessment of voiding function in patients without urinary incontinence (71).

Because this thesis only addresses non-classical procedures, it can be assumed that all individuals underwent complete vaginectomy without urethral lengthening, and vice versa. This of course has an impact on the results, as both procedures involve a variety of risks according to different studies (28,29,31,35,60,72,73). Comparing the findings from the current study with existing literature has to be done with caution. To properly compare a no/partial vaginectomy group with a complete vaginectomy group and a no urethral lengthening group with a urethroplasty group, further research with a larger sample size and including individuals who underwent classical gGAS is advisable. However, the results of this study are indicative as it can be suspected that complete vaginectomy is associated with a higher need for perioperative revision surgery. On the other hand, vaginectomy with concomitant urethral lengthening is probably associated with a higher incidence of urethral fistulas, which can be explained by the fact that no bulbospongiosus tissue is used to cover the proximal urethra. Regarding the occurrence of strictures, there is no consensus yet on whether this is correlated with vaginal preservation. For urethral lengthening, it can be assumed that no urethral lengthening reduces urethral complications (both urethral strictures as urethral fistula formation), implying shorter operating time, shorter hospitalization, better wound healing, and less need for peri- and postoperative revision surgeries.

The option for gGAS procedures deviating from the classical procedures should always be a decision made by the individual, but comprehensive pre-operative counseling is necessary by the healthcare provider to assess the individual's expectations, explain the techniques and surgical options, review all possible intra-, peri- and postoperative complications and communicate about uncertainties therein, and discuss expected results.

4.2 Patient-reported outcomes and satisfaction

Only in the latest years, aesthetic and functional satisfaction and details about sexual activity were questioned in individuals opting for gGAS in our center.

Patient-reported outcomes on aesthetic, functional, and sexual levels are difficult to assess. Reported outcomes in this series were addressed for a minority of the individuals, and therefore cannot be used for data analysis. One individual who underwent metoidioplasty reported dissatisfaction postoperatively, due to the presence of various fistulas following revision surgeries, with a wish for future perineostomy to resolve the problem. Six individuals who underwent phalloplasty specifically mentioned dissatisfaction with one or several aspects of the postoperative result. Reasons given were partial vaginectomy when the individual requested complete vaginectomy in two of them, a desire for aesthetic revision of the phalloplasty that could not be fulfilled because an additional operation was too expensive for the individual, a scrotum correction that could not be performed of the urethra that runs too close to the scrotum in one individual, and two individuals declared that a lack of pre-operative counseling was the reason for their dissatisfaction. Awaiting validated questionnaires, various gender clinics have developed their questionnaires to survey postoperative satisfaction on an aesthetic, functional, and sexual level (62,71,76,80). These reported high satisfaction results both on aesthetic and functional outcomes in individuals who underwent non-classical gGAS, whereas rates of dissatisfaction and regret were low. Causes of dissatisfaction and regret can be related to unmet expectations, treatment outcomes, or complications (61,71,76). Reasons mentioned for dissatisfaction were lack of erectile prosthesis placement (awaiting for), lack of sensitivity in phalloplasty, and lack of length and inability to have sexual intercourse in metoidioplasty (71).

According to several studies, the ability to become sufficiently erect and preserve tactile and erogenous sensations is highly prioritized in individuals opting for gGAS (66,76,80). Regarding the ability to erect, one may assume that all individuals in the metoidioplasty group were able to do so, as the erectile apparatus of the clitoris remains untouched during this procedure, although this was not specifically questioned (62,66). In the phalloplasty group, twelve individuals opted for the implantation of an erectile device, which is only a

minority of the 38 individuals considered for the postoperative period in this thesis. Other individuals may attach less importance to getting an erection, but since this was not specifically asked, this cannot simply be assumed. In addition, TGD individuals can also use other ways to achieve an erection and do not necessarily require an erectile device. However, the advantages and disadvantages of erectile prosthesis placement are not within the scope of this study but should be addressed in future investigations.

Regarding tactile and erogenous sensation, the most sensitive areas and the ability to achieve an orgasm were assessed for several individuals. Following metoidioplasty, the tip of the phallus, the penile shaft, and the vaginal introitus were all once mentioned as the most sensitive genital zone, however, in 85.5% of the individuals, no results were reported, making any assumptions difficult. In the phalloplasty group, the most reported sensitive genital zone was the penoscrotal zone. This is within expectations as the clitoris is buried underneath the base of the neophallus during phalloplasty performed in this center. According to Van de Grift et al. (62), postoperative sexual activity indicated that participants engaged more in masturbation and sexual activity with a partner than before gGAS. However, it may take some time to experience improved sexual function and erogenous and tactile sensation (62). As this topic was prioritized in individuals opting for gGAS, this must be mentioned in pre-operative counseling to avoid wrong expectations (66).

In the last few years, more attention was paid to sexual function postoperatively, and this was consequently assessed in some individuals However, for the majority of individuals, no data were available. To get a thorough insight into patient-reported outcomes and satisfaction ratio, more comprehensive postoperative counseling must be performed in each individual following gGAS.

Despite the fact that there are several recommendations for questionnaires, it remains important that a validated questionnaire is developed, which can be used in all centers. As such, results could be compared across centers. In this thesis, data were collected in an unstructured manner, in the context of the clinical consultation.

4.3 Underlying motives for non-classical treatment requests

In recent years, applications for non-classical gGAS have been increasing in our center (Appendix 5). Reasons for this are varied but may, amongst others, be a consequence of shared-decision making processes during consultation; changing social norms, such as that men should not necessarily be able to void in standing position; more gender non-conforming identities that prioritize other things in gGAS than transgender individuals opting for classical-surgery mostly prioritize; and increased awareness of the different options available in all

TGD individuals seeking healthcare due to comprehensive information that is available on internet.

Overall, two groups of individuals opting for non-classical treatment can be distinguished in this thesis. A total of 35 individuals opted for gGAS without complete vaginectomy and 40 individuals opted for gGAS without urethral lengthening. The underlying motives for requesting non-classical gGAS were reported for this series

Regarding individuals who opted for gGAS without complete vaginectomy, this was a consequence of a protocol change in 21 individuals. During the period from 24/06/2016 up until 20/11/2018, individuals were given the choice between either complete vaginectomy or partial vaginectomy. This additional option was implemented following a period in which some major complications occurred during complete vaginectomy in our center. In these individuals thus, the non-classical surgery could be seen as a result of the protocol at the time rather than an intention for (partial) vaginal preservation of the individual itself. One may assume that only a minor part of these groups would have requested non-classical gGAS if this option was not presented. This was also mentioned by Smith et al. (76), who reported an increase in non-classical treatment requests (almost doubled) since they standardized the way of presenting the technique to individuals. As such, the role of pre-operative counseling in the decision-making process of the individual should not be overlooked (76).

Furthermore, vaginectomy was specifically not performed in agreement with the surgeon due to contraindications prior to primary gGAS in five individuals. And, in nine individuals, the request for vaginal preservation was the specific intention of the individual. Reasons for this request were sexual motivation in three individuals, a wish for a hidden vagina only without further manipulation in one individual, and unspecified in five individuals. Some might have opted for vaginal preservation to prevent complications (4,73). Since the presence of the vagina does not cause gender dysphoria in all TGD individuals, some may choose to preserve their vagina because the risk of vaginectomy does not outweigh it. Even though vaginectomy can be considered to be a safe and simple procedure in experienced hands, an increased risk of complications such as rectal or bladder injury, hematoma, abscess formation, and excessive blood loss are possible complications that may arise and are less likely to occur when vaginectomy is not performed (30,31,60,61,66,73). A study by Beek et al. (4) reported that almost half of the requests for non-classical surgery in their center derived from the risk of complications as an underlying motivation. Most of these requests were formulated by individuals fearing urethral complications, thus not undergoing urethral lengthening, more than they feared complications from vaginectomy. In this series, none of the individuals from the vaginal preservation group that intended vaginal preservation

themselves cited fear of complications as a reason for not undergoing vaginectomy. It can be assumed that complications of vaginectomy are not experienced as a barrier to classical gGAS by the majority of individuals (4).

The underlying reason to request vaginal preservation may also be to align their body with their perceived gender. In this thesis, only one individual described their gender as other than trans-male. In this individual, vaginectomy was not performed for sexual purposes, but one may deduce that given the gender fluidity, this individual did not necessarily feel the need to undergo vaginectomy and that this non-classical approach also aligned the body of that individual with their gender. Some studies examined the impact of gender identity on patient's preferences regarding GAS. Gender non-conforming individuals tend to desire gGAS procedures less often than trans masculine individuals (2,5,63). Koziara et al. (81) and Schaeff et al. (63) reported significantly less desire for GAS in gender-diverse individuals compared to transgender individuals (respectively 81% versus 18%, and 73% versus 2%) (63,81). A study by Beek et al. (4) reported that only 4.1% of their applicants indicated that the partial treatment request was to align their body with their gender identity (4). In this series, however, no data was collected for hormone treatment, voice therapy, top surgery, and other procedures in the masculinization process, making it difficult to compare the number of transgender individuals requesting gGAS with the amount of gender-diverse individuals doing so. Furthermore, Jacobsson et al. (66) reported a significant impact of gender identity on both the importance of vaginal removal and of having a penis that is respectable in places such as male dressing rooms. Although vaginectomy was the lowest prioritized item, this was marked significantly more important in individuals identifying as trans-male, implying that gender-diverse individuals attach less value to whether or not vaginectomy is performed, but one must always take into account that applications and underlying motives differ from individual to individual. Moreover, gender-diverse individuals may render the appearance of their genitalia more ambiguous (7,63,81). However, further research is needed to conclude from this.

Retaining erogenous zones for sexual functioning, not having vaginal dysphoria, and preservation of reproductive options were cited as possible reasons for vaginal preservation requests by different authors (32,60,61,71,82). In this series, three individuals were motivated that their request for vaginal preservation was for sexual purposes. This, amongst other reasons, may be because they would like to maintain the option of receiving penetration during sexual intercourse.

Over a period of 17 years, only 69 individuals were found for inclusion in this thesis on a total of approximately 1500 individuals that underwent gGAS surgery in our center during this

period. This number is rather low. There may be several individuals who received classical gGAS or did not undergo any gGAS at all, but they may have wanted a non-classical approach. Barriers to care are a continuing problem for many individuals and entail different aspects of the transition process. First of all, the lack of support from family and friends along with societal expectations, e.g. that a man should void in a standing position, are often addressed as difficulties in the decision process (4). Furthermore, of high importance is the role of medical professionals as gatekeepers, they should be well educated on current care patterns and have an open view towards individual's wishes. They need to explore the underlying motivations of individuals seeking gender-affirming care and provide individuals with the perspectives needed to make decisions (66). Additionally, some might have the feeling that care is less refined if they undergo non-classical surgery. Accessing gender-affirming care for gender-diverse individuals is often even more complex. Some reported that they feel pressure to present themselves within a binary framework to access treatment (63). Moreover, the majority of insurance companies are still focused on a binary approach to GAS (83,84). This implies that non-classic gGAS applications are often not covered by insurance, which may increase the costs of these approaches (80,83,84).

Of all individuals who opted to undergo gGAS without urethral lengthening, it was not performed in six individuals in agreement with the surgeon due to contraindications prior to primary gGAS. The pre-operative poor urinary function may discourage the surgeon from performing gGAS with urethral lengthening because the risk of postoperative urethral complications is higher for these individuals (32,37,43,56,71). Pre-operative urologic assessment is performed in all individuals planning to undergo gGAS, as such, obstructive pre-operative voiding is detected. To reduce the risk of complications, pre-operative pelvic floor physiotherapy is an option in some individuals to improve urologic function and thus prevent urethral complications later on (28).

In 32 individuals, the request for gGAS without urethral lengthening was the specific intention of the individual. According to other studies, urethral fistula and stricture formation occur in 25-63% and 14-70% of cases respectively, and may require multiple revision surgeries (30,35,51,56,71–75). This may be a reason for TGD individuals to request gGAS without urethral lengthening (4,43,61,71,76). Beek et al. (4) reported that almost half of the applications for partial treatment in their study, and more specifically urethral complications concerning gGAS, were a consequence of fear of complications.

Several studies investigated the importance that individuals attached to standing micturition and its role in the choice of non-classical approaches in masculinizing gGAS. A study by Jacobssen et al. (66) specifically investigated individuals' priorities regarding masculinizing

gGAS. The preservation of orgasmic ability, tactile sensation, and voiding in standing position were considered the most important items (66). Voiding in standing position was ranked less important in 19% of the individuals and as the least important item in 21% of the individuals. Likewise, Kerry et al. (80) reported that almost all individuals in their study desired to be able to void while standing (98%). In contrast, Pigot et al. (71) and Smith et al. (76) specifically reported results in a subgroup of individuals who did not undergo urethral lengthening. They found that voiding while sitting was not seen as a shortcoming, and did not negatively influence gender dysphoria, in individuals who did not prioritize voiding in a standing position (71,76). In this series, no wish for standing micturition was cited the most as an underlying motivation not to perform urethral lengthening. As such, it cannot be assumed that every TGD individual attaches equal importance to micturition in standing position, this varies from individual to individual. While some highly prioritize this, others do not experience this as a necessity in their transition process.

Smith et al. (76) reported that most of their applications for non-classical gGAS without urethral lengthening arose because the individual did not attach importance to urinating in a standing position on the one hand, or due to fear of complications on the other. Similar results are found in this series.

Waterschoot et al. (35) specifically noted that AUL was mainly performed in patients choosing for metoidioplasty as a final GGAS while a less extensive method was generally chosen in patients uncertain about metoidioplasty as a final step (35). However, this is not what was found in the results of this thesis. Most individuals who opted for gGAS without urethral lengthening did not opt for phalloplasty in a later stage but intended gGAS without urethral lengthening for other reasons. Only in four of the 27 included individuals phalloplasty in a second stage was carried out. In addition, there was one individual who indicated a wish for second-stage phalloplasty preoperatively, but who had not yet undergone phalloplasty.

Pigot et al. (71) reported that urinary function is not further compromised in patients with preoperative obstructive voiding if urethral lengthening is not performed. For these individuals, gGAS without urethral lengthening may be a safe alternative. However, if a complete vaginectomy is performed concomitantly, urinary function may still be compromised, as this procedure increases the risk of urethral fistulas.

A frequently voiced request in individuals opting for gGAS is their wish for a ‘normal appearing’ phallus and scrotum (62,66,76). This was a request of one of the individuals in this series. In addition to the performed surgical techniques in our center, a procedure can be performed in which the appearance of a meatus at the apex of the neophallus is created, without undergoing urethral lengthening. This technique was described by Smith et al. (76). A

blind-ending small distal urethra will be created which gives the appearance of a meatus at the penile tip. This option allows a realistic approach to phalloplasty without urethroplasty, which can make individuals less reluctant to choose gGAS without urethral lengthening.

4.4 Study strengths and limitations

This retrospective study is among the first investigations to give a comprehensive overview of techniques, motivation, and outcomes in born-female individuals undergoing non-classical gGAS. Despite the retrospective design of this thesis, all applicable STROBE guidelines were followed to generate the most reliable results possible (68). The observations in this study can be used by other clinics to gain insight into the development of non-classical surgery in born-female individuals. However, the results have to be interpreted within the context of some limitations as well.

The generalizability of the findings presented here is limited by the retrospective nature of the study making this thesis prone to confounding factors. Also, the study population only consisted of 69 individuals with a relatively short follow-up, which contributes to the potential for type II errors. This entails a potentially higher risk on false negative results. Although statistically significant results were achieved, a larger number of cases could further confirm assumptions made in this thesis, and a longer follow-up time in future studies may provide a more complete insight into postoperative developments.

Initially, the aim was to create a dataset of all individuals who received non-classical masculinizing genital gender affirmation surgery in the past 30 years in our gender clinic at the Ghent University Hospital, starting in February 1993 up until February 2023. As it was impossible to get access to the non-digitalized records (1993-2006), the study was limited to data available in the EPR. Interesting data may be lost by only including individuals from the start of the electronic patient record. A study by Weyers et al. (31) published in 2006, reported that 'many choose to leave the vagina unchanged in situ'. No report was made about the number of individuals opting for this, yet it does imply that non-classical surgeries were already performed before 2006, whether or not in our center. In the EPR, data up to 2006 could be accessed, however, data reported at the beginning of the EPR were often still of lower quality than today. Although missing data were always reported, some important information may be lost due to these missing data. On the other hand, the long recruitment period may have introduced a degree of heterogeneity due to slight changes in the protocol or the individual surgeon's preferences and skills. In total, our recruitment period comprises all individuals who underwent non-classical gGAS from 2006 up until 2023. Partial vaginectomy and perioperative coronaplasty are procedures during gGAS of which the

protocol temporarily changed during this period. There may be other protocol changes that were not detected and that possibly had an influence on the results of this thesis as well.

Since this thesis only considered individuals who underwent non-classical gGAS, there is an overlap in the no/partial vaginectomy and no urethral lengthening groups, which may impact the reported results. A control group of individuals undergoing classical gGAS is needed for the correct interpretation of the results.

Five individuals in the metoidioplasty dataset and 16 individuals in the phalloplasty dataset had a nationality other than Belgian. For these individuals, follow-up was often less thorough as it was partly remote. Information on these individuals was often incomplete, and certain operations and redo operations were performed in the country of residence resulting in missing details in the analyzed patient records. Nonetheless, these individuals were included in the dataset if they had a follow-up time of more than six months, but the lack of information for this specific subgroup of individuals must be taken into account during analyzation of the results Finally, this study reflects the experience of a mostly white, European participant cohort and hence is not representative of the wider community.

The subjective variables in this thesis, including the underlying motivation for non-classical gGAS and patient-reported outcomes on satisfaction and functioning, were not surveyed using a validated questionnaire. During pre-operative counseling, only limited attention was paid to which aspects of gGAS were a priority in individuals, leading to a lot of missing values. This could be improved in future studies. It is important that the patient's expectations are properly explored during pre-operative counseling, and that the underlying motivation for the individual's ultimate choice for classical or non-classical surgery is discussed and reported. Also, a comprehensive assessment of patient-reported outcomes is necessary. Unfortunately, there is a lack of patient-reported outcome measures validated for TGD individuals to objectively evaluate and compare the influence of these surgical procedures (56). Furthermore, the relatively limited follow-up time might have limited the detection of improvements (or deteriorations) in sexual outcomes resulting from processes that are likely to take a longer time.

The data represents a single-center experience of the Ghent University Hospital, limiting the generalizability of the outcomes reported above. Moreover, this thesis focuses solely on gGAS. However, this can be seen as a strength as the underlying motivation to request non-classical gGAS may be very different than for other non-classical approaches or partial treatment requests in born-female individuals.

4.5 Implications for future research

As individuals became increasingly involved in healthcare decision-making over time, the option of not undergoing all components of the classical approach is increasingly being offered. In the gender clinic at the Ghent University Hospital, currently, 18 surgical techniques are provided to choose from (See Appendix 4). Surgical options for TGD individuals will continue to expand in the future, as a result of ongoing advancements and innovations made in the field of gynecology, urology, and plastic surgery. Moreover, the evolving societal perspective on gender must be taken into account in future studies. These factors contribute to the fact that non-classical masculinizing gGAS requests are expected to increase even more within the coming years. Further, studies must not only consider the issue of gender identity but also variables and markers such as race, class, religion, sexuality, and nationality.

Ideally, a prospective, long-term study should be initiated, including both individuals opting for classical gGAS and non-classical gGAS. Validated comprehensive pre-operative counseling in all individuals should be performed. Thereby, focusing on identifying patient motives and goals for their GAS, barriers to achieving these goals, the impact of various treatments on outcomes, as well as overall sexual, urinary, and mental well-being from these various interventions (20). The outcomes of open questions can be helpful in the further development of the preoperative counseling process. A decision aid, as developed by Amsterdam University may be useful for individuals to help decide which gGAS procedure is the most suitable for that particular individual (20). Besides, future research should incorporate patient-reported functional, aesthetic, and sexual outcomes, which ideally are obtained through a validated questionnaire developed for this patient population. Relevant variables to be considered amongst other topics, are rates for functional and aesthetical satisfaction, overall satisfaction, the ability to reach an orgasm pre- and postoperatively, length of the neophallus in erection, the most sensitive genital area, the presence of a partner, pre-and postoperative sexual functioning, quantity of sexual functioning, sexual preferences, and improved sexual self-esteem. Furthermore, the individual's socioeconomic status, the impact of long-term recovery from surgery, both mentally and physically, and reintegration into society may be considered interesting topics for future research (62).

Finally, it should be mentioned that a majority of TGD studies focus on masculinizing gGAS. Sufficient research must be conducted for de-masculinizing and feminizing gGAS as well, and more specifically the non-classical approaches therein.

The results of such a study can contribute to better clinical practice, which is important to involve patient-centered care. Despite considerable advancements, healthcare providers and

society as a whole must continue to prioritize improving the approach to gender dysphoric individuals in care. Individuals must be supported to make an informed choice based on comprehensive explanations that highlight the expectations and contraindications of each procedure. All individuals regardless of gender and reason for application should have the same opportunities to receive care adapted to their request.

4.6 Conclusion

This thesis aimed to describe surgical techniques and outcomes of all individuals who underwent masculinizing non-classical genital gender-affirming surgery in one single-center from January 2006 to February 2023. Overall, this retrospective cohort analysis provides important insight into the impact of an individualized approach on outcomes following genital gender reassignment surgery. The thesis highlights the importance of tailoring surgical approaches to meet each patient's specific needs and underscores the potential benefits of non-classical approaches in gGAS. gGAS without urethral lengthening results in fewer urethral complications postoperatively, whereas vaginal preservation reduces the risk of complications associated with vaginal preservation, such as hematoma and perforation to the neighboring organs. An association between vaginal preservation and the occurrence of fistula formation could not be demonstrated, because the study design did not allow for this.

The most cited reasons for requesting non-classical surgery involved sexual motivation in the vaginal preservation group and no wish for standing micturition along with fear of complications in the no urethral lengthening group. Furthermore, non-classical approaches were performed according to the protocol at the time or because classical gGAS was contraindicated. Results on patient-reported outcomes were not assessed because less data was available on these topics. Future investigations must be performed to gain insight into postoperative voiding function, and aesthetic and sexual outcomes.

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6. Appendix

Appendix 1: List of abbreviations

ALT	Anterolateral thigh
AUL	Additional urethral lengthening
BMI	Body mass index
GAS	Gender-affirming surgery
gGAS	Genital gender-affirming surgery
GnRH	Gonadotrophin-releasing hormones
NCgGAS	Non-classical genital gender-affirming surgery
RFF	Radial free forearm
SCIAP	Superficial circumflex iliac artery perforator
STG	Split-thickness graft
SPC	Suprapubic catheter
TGD	Transgender and gender diverse
TUC	Trans urethral catheter
UL	Urethral lengthening

Appendix 2: Surgical characteristics and outcomes of individuals who underwent non-classical metoidioplasty

N°	Age at surg (years)	Follow-up (months)	Type Vagin-ectomy	Reason if not complete	Urethral lengthening	Reason if not complete	Type clitoral release	Type scroto-plasty	Fistula + location	Stricture + location	Urethro-plasty # revision	Revision surgery other	Step-up phallo-plasty	Final position meatus	Functional satisfaction
1	37	43	none	intention individual	complete	NA	ventral + dorsal	A only	yes – proximal	yes – ANP	2	vaginectomy	yes	along penile shaft	SM
2	59	24	none	CI	complete	NA	ventral + dorsal	A only	yes – ANP	no	SM	SM	yes	SM	SM
3	61	64	none	CI	complete	NA	ventral + dorsal	A only	yes – distal	yes – distal	3	no	no	SM	yes
4	34	56	partial	protocol	proximal urethra	during future step-up	none	A only	no	no	0	no	yes	perineal	SM
5	21	50	partial	protocol	proximal urethra	during future step-up	none	A only	no	yes – meatal	0	no	no	perineal	SM
6	19	85	partial	protocol	complete		ventral + dorsal	A only	no	yes – meatal	0	no	yes	along penile shaft	SM
7	30	6	partial	protocol	none	intention individual	ventral + dorsal	A only	no	No	0	no	no	perineal	yes
8	19	54	partial	protocol	complete	NA	ventral + dorsal	A only	yes – urethro-vaginal	yes – ANP	3	vaginectomy	no	penoscrotal	SM
9	31	59	none	intention individual	complete	NA	ventral + dorsal	A only	yes - urethro-vaginal	no	3	no	no	along penile shaft	no
10	40	36	none	intention individual	perineostomy	intention individual	ventral + dorsal	none	no	no	0	no	no	perineal	SM
11	47	24	complete	NA	perineostomy	intention individual	none	A only	no	no	0	scrotoplasty	no	perineal	SM
12	45	33	complete	NA	perineostomy	intention individual	ventral + dorsal	A only	no	no	0	no	no	perineal	yes
13	23	33	complete	NA	perineostomy	intention individual	ventral + dorsal	A only	no	no	0	PO: drainage hematoma + bleeding a. uterina	no	perineal	yes
14	25	26	complete	NA	none	CI	none	A + P	SM	SM	SM	no	no	perineal	yes
15	36	22	complete	NA	perineostomy	intention individual	ventral + dorsal	A + P	no	no	0	PO: drainage hematoma	no	perineal	yes

* no follow-up >= 6 months, only included for pre-, and intra-operative data
NA: not applicable – SM: system missing – CI: contraindication – Scrotoplasty, A : anteriorization, P : posteriorization – Fistula and stricture, ANP: Anastomosis pars nativa – proximal urethra – PO: perioperative

Appendix 2: Surgical characteristics and outcomes of individuals who underwent non-classical metoidioplasty (continued)

N°	Age at surg (years)	Follow-up (months)	Type Vagin-ectomy	Reason if not complete	Type urethroplasty	Reason if not complete	Type clitoral release	Type scroto-plasty	Fistula	Stricture	Urethro-plasty # revision	Revision surgery other	Step-up phallo-plasty	Final position meatus	Functional satisfaction
16	25	19	none	intention individual	perineostomy	intention individual	ventral + dorsal	A only	no	no	0	no	no	perineal	yes
17	23	9	complete	NA	perineostomy	CI	ventral	A only	no	no	0	no	no	perineal	yes
18	21	12	complete	NA	perineostomy	intention individual	ventral	A only	no	yes – perineal	1	no	no	perineal	yes
19	20	11	complete	NA	perineostomy	intention individual	ventral	A + P	no	no	0	no	no	perineal	yes
20	36	9	complete	NA	perineostomy	CI	ventral + dorsal	A + P	no	no	0	no	no	perineal	yes
21	25	7	complete	NA	perineostomy	intention individual	ventral + dorsal	A only	no	yes – perineal	1	removal vaginal rest	no	perineal	SM
22*	50	< 6	complete	NA	perineostomy	intention individual	ventral + dorsal	A + P	NA	NA	NA	NA	NA	NA	NA
23*	23	< 6	complete	NA	perineostomy	intention individual	ventral + dorsal	A + P	NA	NA	NA	NA	NA	NA	NA
24*	23	< 6	none	intention individual	perineostomy	intention individual	ventral + dorsal	A + P	NA	NA	NA	NA	NA	NA	NA
25*	27	< 6	complete	NA	perineostomy	intention individual	ventral + dorsal	A + P	NA	NA	NA	NA	NA	NA	NA
26*	21	< 6	complete	NA	perineostomy	intention individual	ventral + dorsal	A + P	NA	NA	NA	NA	NA	NA	NA
27*	26	< 6	complete	NA	perineostomy	intention individual	ventral + dorsal	A + P	NA	NA	NA	NA	NA	NA	NA

* no follow-up >= 6 months, only included for pre-, and intra-operative data
NA: not applicable – SM: system missing – CI: contraindication – Scrotoplasty, A : anteriorization, P : posteriorization – Fistula and stricture, ANP: Anastomosis pars nativa – proximal urethra – PO: perioperative

Appendix 3: Surgical characteristics and outcomes of individuals who underwent non-classical phalloplasty

N°	Age at surg (years)	Follow-up (months)	Type flap phallus	Prior meta	Type Vagin-ectomy	Reason if not complete	Type urethroplasty	Reason if not complete	Type flap urethra	Type scroto-plasty	Fistula	Stricture	Urethro-plasty # revision	Flap related comp.	Revision surgery other	Aesthetic revisions	Final position meatus	Satisfaction (overall / aesthetic / functional)
1	50	33	ALT	no	none	CI	complete	NA	RFF	A + P	yes – AFP	no	1	no	no	lipofilling scar (x2), correction phallic tip	along penile shaft	SM
2	41	26	RFF	no	none	CI	complete	NA	RFF	A + P	yes – multiple	yes – meatal	1	no	no	no	along penile shaft	yes
3	22	110	ALT	no	none	CI	complete	NA	SCIAP	A + P	no	no	0	no	no	no	along penile shaft	yes
4	39	74	ALT	no	none	intention individual	complete	NA	SCIAP	A + P	yes – pars fixa	no	2	no	no	liposuction phallus (x2)	along penile shaft	SM
5	18	18	RFF	no	partial	intention individual	complete	NA	RFF	A + P	yes – pars fixa	yes – AFP	3	PO: complete necrosis urethra	PO: STG for necrotic urethra	no	perineal	SM
6	23	61	RFF	no	partial	protocol	complete	NA	RFF	A + P	yes – pars pendulans	yes – unknown	3	PO: partial necrosis urethra	PO: debridement + temporary perineostomy	VY-scroto-plasty + Z-plasty + liposuction	along penile shaft	SM
7	43	83	RFF	no	partial	protocol	complete	NA	RFF	A + P	yes – multiple	no	1	no	PO: venous thrombosis: end-to-end closure veins	lipofilling scar	along penile shaft	SM
8	42	80	RFF	no	partial	protocol	complete	NA	SCIAP	A + P	yes – urethro-vaginal	no	3	no	no	centrali-zation phallus + Z-plasty	SM	SM
9	41	55	RFF	no	partial	protocol	complete	NA	RFF	A + P	yes – urethro-vaginal	yes - AFP	4	Complete necrosis urethra	Repair urethra with SCIAP + vaginectomy	scrotal correction	penoscrotal	SM

* no follow-up >= 6 months, only included for pre-, and intra-operative data

NA: not applicable – SM: system missing – CI: contraindication – Flap: RFFF: radial free forearm flap, ALT: anterolateral thigh flap, SCIAP: superficial circumflex iliac artery flap – Scrotoplasty, A: anteriorization, P: posteriorization, if prior metoidioplasty: anteriorization during meta and posteriorization during phalloplasty – Fistula and stricture, AFP: anastomosis pars fixa – pars pendulans

Appendix 3: Surgical characteristics and outcomes of individuals who underwent non-classical phalloplasty (continued)

N°	Age at surg (years)	Follow-up (months)	Type flap phallus	Prior meta	Type Vagin-ectomy	Reason if not complete	Type urethroplasty	Reason if not complete	Type flap urethra	Type scoto-plasty	Fistula	Stricture	Urethro-plasty # revision	Flap related comp.	Revision surgery other	Aesthetic revisions	Final position meatus	Satisfaction (overall / aesthetic / functional)
10	18	82	RFF	no	partial	protocol	complete	NA	RFF	A + P	yes – urethro-vaginal	yes – pars fixa	8	no	PO: venous thrombosis: end-to-end closure veins+ vaginectomy -> ! complete urethral transection during surgery	no	along penile shaft	SM
11	43	20	RFF	no	partial	protocol	complete	NA	RFF	A + P	yes – pars pendulans	no	0	no	PO: drainage abscess (2x)	no	along penile shaft	SM
12	29	6	RFF	yes	partial	intention individual	complete	NA	RFF	A + P	yes – multiple	no	2	PO: partial necrosis urethra	PO: debridement + temporary perineostomy	no	along penile shaft	no
13*	27	< 6	ALT	no	partial	protocol	complete	NA	SCIAP	A + P	NA	NA	NA	NA	NA	NA	NA	NA
14	18	29	ALT	no	partial	protocol	complete	NA	SCIAP	A + P	no	no	0	no	vaginectomy	liposuction phallus (x2)	along penile shaft	yes
15	20	74	RFF	no	partial	protocol	complete	NA	RFF	A + P	no	yes – AFP	2	no		meatal correction	along penile shaft	SM
16	32	28	RFF	no	partial	protocol	complete	NA	RFF	A + P	yes – AFP	no	2	PO: partial necrosis urethra	PO: debridement	no	perineal	SM
17	18	43	RFF	no	partial	protocol	complete	NA	RFF	A + P	yes – AFP	yes - meatal	0	PO: partial necrosis urethra	PO: drainage hematoma + PO: debride-ment + PO: cyst removal	no	along penile shaft	SM
18	28	53	RFF	no	partial	intention individual	complete	NA	RFF	A + P	yes – pars pendulans	yes – meatal	3	no	no	Lipofilling scar + liposuction phallus (x3) + Z-plasty	along penile shaft	yes

* no follow-up >= 6 months, only included for pre-, and intra-operative data

NA: not applicable – SM: system missing – CI: contraindication – Flap: RFFF: radial free forearm flap, ALT: anterolateral thigh flap, SCIAP: superficial circumflex iliac artery flap – Scrotoplasty, A: anteriorization, P: posteriorization, if prior metoidioplasty: anteriorization during meta and posteriorization during phalloplasty – Fistula and stricture, AFP: anastomosis pars fixa – pars pendulans

Appendix 3: Surgical characteristics and outcomes of individuals who underwent non-classical phalloplasty (continued)

N°	Age at surg (years)	Follow-up (months)	Type flap phallus	Prior meta	Type Vagin-ectomy	Reason if not complete	Type urethroplasty	Reason if not complete	Type flap urethra	Type scoto-plasty	Fistula	Stricture	Urethro-plasty # revision	Flap related comp.	Revision surgery other	Aesthetic revisions	Final position meatus	Satisfaction (overall / aesthetic / functional)
19	24	17	RFF	no	partial	protocol	complete	NA	RFF	A + P	no	no	0	no	PO: venous thrombosis: end-to-end closure veins + PO: scrotal debridement	no	along penile shaft	SM
20	20	25	ALT	no	partial	protocol	complete	NA	ALT	A + P	yes – perineal	yes – AFP	2	no	PO: drainage hematoma	no	perineal	SM
21	22	14	ALT	no	partial	protocol	complete	NA	ALT	A + P	yes - AFP	yes – AFP	0	no	no	no	along penile shaft	SM
22	37	62	ALT	no	partial	protocol	complete	NA	ALT	A + P	yes	yes – unknown	3	no	no	no	along penile shaft	SM
23	21	60	ALT	no	partial	protocol	complete	NA	SCIAP	A + P	no	yes - unknown	1	complete necrosis urethra	STG-covering urethra + revision scrotum	liposuction phallus (x2)	perineal	SM
24	20	37	RFF	no	complete	NA	perineostomy	intention individual	NA	meta: A, phallo: P	yes – unknown	no	0	no	no	Centrali-zation phallus + scrotal revision	penoscrotal	SM
25	42	33	ALT	no	complete	NA	none	intention individual	NA	A + P	no	no	0	no	drainage abcess (x2) + closure vesico-vaginal fistula	no	Anatomic female	SM
26*	35	< 6	ALT	no	complete	NA	perineostomy	SM	NA	A + P	NA	NA	NA	NA	NA	no	NA	NA
27	20	26	SCIAP	no	complete	NA	perineostomy	intention individual	NA	A + P	yes – AFP	no	0	no	no	liposuction phallus	perineal	SM
28	21	22	ALT	no	complete	NA	perineostomy	CI	NA	A + P	no	no	0	no	no	liposuction phallus	perineal	yes

* no follow-up >= 6 months, only included for pre-, and intra-operative data

NA: not applicable – SM: system missing – CI: contraindication – Flap: RFFF: radial free forearm flap, ALT: anterolateral thigh flap, SCIAP: superficial circumflex iliac artery flap – Scrotoplasty, A: anteriorization, P: posteriorization, if prior metoidioplasty: anteriorization during meta and posteriorization during phalloplasty – Fistula and stricture, AFP: anastomosis pars fixa – pars pendulans

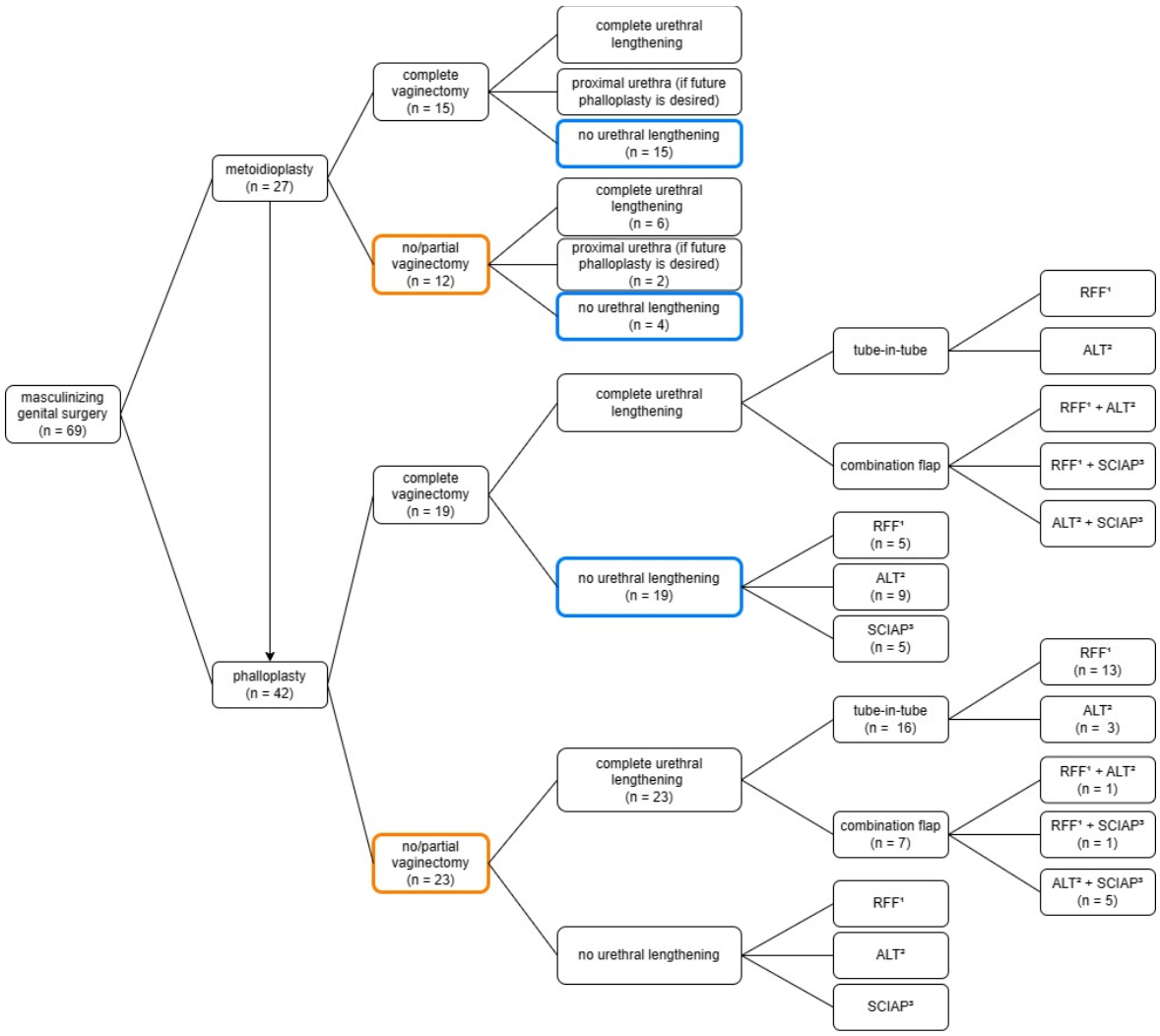
Appendix 3: Surgical characteristics and outcomes of individuals who underwent non-classical phalloplasty (continued)

N°	Age at surg (years)	Follow-up (months)	Type flap phallus	Prior meta	Type Vagin-ectomy	Reason if not complete	Type urethroplasty	Reason if not complete	Type flap urethra	Type scoto-plasty	Fistula	Stricture	Urethro-plasty # revision	Flap related comp.	Revision surgery other	Aesthetic revisions	Final position meatus	Satisfaction (overall / aesthetic / functional)
29	46	16	RFF	no	complete	NA	perineostomy	intention individual	NA	A + P	no	no	0	no	no	correction frenulum	perineal	yes
30	22	19	RFF	no	complete	NA	perineostomy	CI	NA	A + P	no	no	0	no	no	no	perineal	SM
31	24	15	RFF	yes	complete	NA	perineostomy	intention individual	NA	meta: A, phallo: P	no	no	0	no	no	no	perineal	yes
32	29	18	SCIAP	no	complete	NA	perineostomy	intention individual	NA	A + P	no	no	0	no	no	no	perineal	yes
33	19	12	SCIAP	no	complete	NA	perineostomy	intention individual	NA	A + P	no	no	0	no	no	no	perineal	yes
34	22	12	ALT	yes	complete	NA	perineostomy	intention individual	NA	meta: A, phallo: P	no	no	0	no	no	liposuction phallus	perineal	yes
35	26	13	ALT	no	complete	NA	perineostomy	intention individual	NA	A + P	no	no	0	no	no	liposuction phallus	perineal	yes
36	26	12	ALT	no	complete	NA	perineostomy	intention individual	NA	A + P	no	no	0	complete phallic necrosis	PO: debridement phallus + ALT phallo-plasty	no	perineal	yes
37	39	11	SCIAP	no	complete	NA	perineostomy	intention individual	NA	A + P	no	no	0	no	no	no	perineal	SM
38	22	10	SCIAP	no	complete	NA	perineostomy	intention individual	NA	A + P	no	no	0	no	no	no	perineal	yes
39	26	7	ALT	no	complete	NA	perineostomy	intention individual	NA	A + P	no	no		complete phallic necrosis	PO: SCIAP phalloplasty	no	perineal	SM
40	23	8	ALT	no	complete	NA	perineostomy	intention individual	NA	A + P	no	no	0	no	no	no	perineal	yes
41*	21	< 6	RFF	no	complete	NA	perineostomy	intention individual	NA	A + P	NA	NA	NA	NA	NA	NA	NA	NA
42*	22	< 6	ALT	no	complete	NA	perineostomy	intention individual	NA	A + P	NA	NA	NA	NA	NA	NA	NA	NA

* no follow-up >= 6 months, only included for pre-, and intra-operative data

NA: not applicable – SM: system missing – CI: contraindication – Flap: RFFF: radial free forearm flap, ALT: anterolateral thigh flap, SCIAP: superficial circumflex iliac artery flap – Scrotoplasty, A: anteriorization, P: posteriorization, if prior metoidioplasty: anteriorization during meta and posteriorization during phalloplasty – Fistula and stricture, AFP: anastomosis pars fixa – pars pendulans

Appendix 4: Flow chart of available options for de-feminizing and masculinizing genital gender-affirming surgeries in the genital center of the Ghent University Hospital. Numbers of non-classical applicants during 2016 and 2023 are reported. Orange = no complete vaginectomy performed, blue = no urethral lengthening performed.



¹ RFF = radial free forearm
² ALT = anterolateral thigh
³ SCIAP = superficial circumflex iliac artery phalloplasty

Appendix 5 Non-classical gGAS surgeries performed in our center from 2006 to 2023 for phalloplasty and metoidioplasty. Orange = no complete vaginectomy, Blue = no urethral lengthening.